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UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

ANIMAL HUSBANDRY RESEARCH DIVISION

and

COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF
BREEDING METHODS

1968 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

April 4, 5, and 6, 1968
Tucson, Arizona

PROCEEDINGS OF THE
ANNUAL MEETING OF THE
TECHNICAL COMMITTEE
CURRENT SEXUAL RECORDS

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1968
Annual Report of W-1
and
Report of
Annual Meeting of Technical Committee

Tucson, Arizona
April 4, 5, and 6, 1968

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AGENDA

W-1 Technical Committee Meeting

University of Arizona
Tucson, Arizona
April 4, 5, and 6, 1968

Ross E. Christian, Chairman

Thursday

8:00 A.M.

Welcome

Dr. R. K. Frevert, Director

Arizona Agricultural Experiment Station

Station Reports

Arizona, California, Colorado, Hawaii, Idaho,
Montana, U. S. Range Livestock Experiment
Station, Nevada, New Mexico, Oregon, Utah,
Washington, and Wyoming

1:00 P.M.

Project Revisions

Reports of Committees

Testing of Inbred Line Concept

C. B. Roubicek, Chairman

Feed Efficiency

R. L. Blackwell, Chairman

Friday

8:00 A.M.

Cooperation with United States Meat Animal
Research Center

Regional Bulletin

Computer Programs

Business Meeting

1:00 P.M.

Tour of Arizona Agricultural Experiment Station
Bulls on Test

Saturday

8:00 A.M.

Tour San Carlos Indian Reservation

Lunch at Ranch

ADJOURN

PERSONNEL

Project Leaders

Carl B. Roubicek*	Arizona
Donald E. Ray	Arizona
W. C. Rollins*	California
J. S. Brinks*	Colorado
E. H. Cobb*	Hawaii
Diedrich Reimer	Hawaii
R. E. Christian*	Idaho
R. L. Blackwell* (Chairman)	Montana
C. M. Bailey*	Nevada
L. A. Holland*	New Mexico
Ralph Bogart*	Oregon
J. A. Bennett*	Utah
C. C. O'Mary*	Washington
G. E. Nelms*	Wyoming
J. J. Urick**	U. S. Range Livestock Experiment Station

Administrative Adviser

R. K. Frevert^{oo}

Agricultural Research Service

Bradford W. Knapp Acting Investigations Leader

Cooperative State Research Service

Carl F. Sierk Assistant Administrator

Guests Present

E. B. Stanley	University of Arizona
B. R. Taylor	University of Arizona
W. H. Hale	University of Arizona
L. W. Dewhirst	University of Arizona
Paul O. Stratton	University of Wyoming

*Voting members

**Representing O. F. Pahnish

^{oo}Representing J. H. Meyer, Administrative Adviser, W-1

W-1 TECHNICAL COMMITTEE MEETING

University of Arizona
Tucson, Arizona
April 4, 5, and 6, 1968

Ross E. Christian, Chairman

The W-1 Technical Committee convened at 8:15 A. M. in Room 353 of the Student Union. The meeting was called to order by the chairman, Dr. Christian, who introduced Dr. R. K. Frevert, Director of the Arizona Agricultural Experiment Station.

Dr. Frevert:

We are delighted to have you here. W-1 is a project that has maintained a good deal of prestige through a considerable number of years. Arizona has been pleased to participate since its start.

I presume most of you have visited the University of Arizona before. In the State of Arizona long ago agriculture dropped out of the number one place so far as the rank in income is concerned, but I think that has happened in all but two of the states. We were second for a number of years, then mining moved up to number one. Tourism is a pretty close fourth, agriculture is third, and manufacturing second. With the mine strikes this year, agriculture may pull ahead temporarily.

Income from agricultural products runs between \$500 million and \$600 million a year, which is about median in the Western states. California, Colorado, and Washington are ahead of us. Oregon is about the same with forest products excluded. We do this on about 1.25 million crop acres, essentially all irrigated, and a considerable area of range land varying from not so good to good through the state.

In agricultural income, for many years cotton was our number one cash crop. It has fallen with the surplus of cotton and restrictions on the crop, and cattle and livestock have moved substantially above cotton.

The University of Arizona also has grown. I have been here ten years, and it has moved from a little less than 10,000 to 22,000 students. This has given us a lot of growing pains. We have a good many new buildings including, about six or eight years ago, a new Home Economics building, Agricultural Sciences building, and remodeling of the old Agricultural Building. We are still crowded.

The University has thirteen colleges. The newest of these is a College of Medicine. The first class of 32 students started this past

fall and they are in a new building out on the old poultry farm. The basic sciences building is completed and in use, and there is a \$14 million hospital which will be under way rather soon.

The College of Agriculture work is rather traditional. We have sixteen departments including home economics. In animal science we have animal science, dairy science, poultry science, pathology. We have 1,300 students. About 300 graduate students in the total College of Agriculture. Experiment stations--this is a conventional mode of operation. We have outlying stations. The branch station at Yuma is 1,000 feet above sea level, Phoenix is 1,000 feet elevation, Tucson is 2,000 feet, and Safford is 3,000 feet above sea level. This makes a good deal of difference so far as crops are concerned. The difference between Tucson and Yuma in cattle feeding is substantial. We do have most of our livestock work here at the University. We have, however, a very satisfactory cattle feeding operation at Yuma. We have considerable emphasis on nutrition. The biochemistry department works closely with the animal science departments, and home economics has a human nutrition department which works closely with us. Also, there is environmental work. We feel that with the "hottest" station in the country we should be working on these problems.

Our main problems in the state--water is number one. Two-thirds of our water supply is from underground. About half of the underground supply comes from areas of declining water level and about a third replenished or partially replenished. We get lots of brush fires. Our latest problem is boll weevil in cotton.

One of our real problems is the problem of the economics of using the expensive land and how it can pay off in an operation.

We are delighted to have you here.

S T A T I O N R E P O R T S

UNIVERSITY OF ARIZONA

- I. Station: Arizona Agricultural Experiment Station
- II. Project title: 1. Breeding and selection of beef cattle for the Southwest. 2. Progeny testing of selected Hereford sires.
- III. Personnel:

Experiment Station:

C. B. Roubicek, Project Leader, D. E. Ray, L. W. Dewhirst,
A. M. Lane, and B. R. Taylor

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

IV. Nature and extent of work done this year:

An additional data collection period in June has been included in the project. All cows and calves are weighed and a complete evaluation made of the udder of each cow.

Manuscripts have been prepared and submitted to the Journal of Animal Science on analyses of blood and liver data and on the weaning performance from the topcross test.

V. Summary of progress:

The performance of progeny from three topcross sire and dam lines and an industry herd was evaluated. Data were collected from 400 calves during a four year period (table 1).

Table 1. Experimental Design with Number of Observations

Line of Dam	Line of Sire				Total
	Line 1	Line 6	Line 9	San Carlos	
Line 1	7	11	22	27	67
Line 6	24	5	24	27	80
Line 9	24	12	7	34	77
San Carlos	51	16	44	65	176
Total	106	44	97	153	400

Dam line exerted a greater influence on preweaning growth than did sire line, whereas birth weight and conformation score were influenced more by sire line. Calves with the highest weaning weight by dam line had the lowest weight by sire line. It appears that maternal ability is more important in determining weaning weight performance

Table 2. Mean Squares from Analyses of Variance

Source of variation	d.f.	Birth weight	Weaning weight	Daily gain birth to weaning	Conformation score ¹	Condition score ¹
Sire line	3	197.7*	3593.3	0.0487	3.875**	2.392*
Dam line	3	31.6	7567.3*	0.1282*	1.307	2.407*
Years	3	1604.0**	62228.4**	1.3826**	4.646**	11.822**
Age of dam	2	298.4*	10531.5*	0.1076	1.103	1.858
Sex	1	118.0	30186.4**	0.4335**	3.117*	1.905
SL x DL	9	49.4	3140.9	0.0519	0.724	0.516
SL x Sex	3	69.3	1269.5	0.0142	0.575	0.849
DL x Sex	3	117.2	1751.3	0.0359	0.434	0.179
Year x Sex	3	101.5	1123.3	0.0394	0.859	3.231**
Age dam x sex	2	43.4	1403.5	0.0132	0.186	0.495
Regression ²	1	113.5	204417.5*	0.2316*	7.383**	21.478**
Residual	366	74.7	2405.0	0.0376	0.701	0.830

¹Evaluated on a 15 point scale, with higher values indicating more desirable conformation or higher condition.

²Continuous partial regression of dependent variable on age at weaning

*P < .05

**P < .01

Table 3. Comparisons of Sire Line and Dam Line by Deviations from Least-Squares Means

Variable	Line 1	Line 6	Line 9	San Carlos
Birth weight (kg):				
Sire line deviation	0	0.3	-1.0	0.7
Dam line deviation	0	-.5	0.3**	0.2
Mean			33.5	
Weaning weight (kg):				
Sire line deviation	-.7	-4.3	0.9	4.1*
Dam line deviation	-1.3	8.2**	-4.5	-2.4
Mean			217.1	
Daily gain birth to weaning (kg):				
Sire line deviation	-.002	-.019	0.007	0.014*
Dam line deviation	-.007	0.034**	-.019	-.008
Mean			0.712	
Conformation score (units) ²				
Sire line deviation	-.20	-.21	0.16	0.25**
Dam line deviation	-.07	0.23**	-.05	-.11
Mean			11.26	
Condition score (units) ² :				
Sire line deviation	-.20	-.13	0.20**	0.13**
Dam line deviation	0.05*	0.26**	-.14	-.17
Mean			10.84	

¹Evaluated on a 15 point scale, with higher values indicating more desirable conformation or higher condition.

*P < .05

**P < .01

than differences in genetic growth potential and suggests a negative relationship between maternal ability and genetic growth potential.

VII. Work planned for the future:

The termination of the Agricultural Research Service cooperative agreement for the line test program does present difficulties in completing the feedlot test of the bull progeny. We expect to continue collecting range and reproductive performance data for the test progeny. This will be the last (4th) breeding season for the line test program.

VIII. Publications and manuscripts:

Taylor, R. L. 1967. Genetic and environmental influences upon certain hepatic and blood constituent concentrations in Southwestern range cattle. Ph. D. Thesis. University of Arizona. Tucson.

IX. Project summary:

Arizona Agricultural Experiment Station

Cattle Inventory - June 30, 1967		
Breed		Hereford
Purebred or grade		Purebred
Bulls (12 mo. or over)		112
Cows (2 yr. or over)		481
Heifers (yearlings)		162
Calves - bulls		201
- heifers		206
Cow Production Data - 1967 calf crop		
Number cows bred to calve:		
As 3-yr.-olds and up		483
Number calves born - alive		407
- dead		4
Cows died at parturition		2
Calves weaned		407
Percent calf crop - born		84.2
- weaned		83.4
Preweaning Performance - 1967 calf crop		
	Bulls	Heifers
Birth weight	71	67
Weaning age	248	247
Weaning weight - lb.	412	387
Weaning score::		
Condition	8.2	8.8
Conformation	10.7	10.6

SUMMARY OF INDIVIDUAL DATA ON REGIONAL BULLS USED AT ARIZONA DURING THE 1968 BREEDING SEASON

Name and origin of bull	Tattoo and registra- tion number	Birth weight Act.Dev.	Weaning weight Act. Dev.	Adjusted weaning weight Act.Dev.	Daily gain on test Act. Dev.	Feed efficiency Act. Dev.	Days on test Act.Dev.	Final					
								weight off test Act.Dev.	Age test off test Act.Dev.				
MSC Supreme 18	533												
Bozeman, Montana	13691025	70 -6.5	325	-34	385 -22	3.01	.36	140	0	844	53	353	-6
L14 Mixer 170	6114												
Miles City, Mont.	14402147	79 3	455	90	429 42	3.22	.69	196	0	1057	197	409	20
L4 Mischief 132	6236												
Miles City, Mont.	14402279	92 12	417	88	398 58	2.85	.30	196	0	987	151	403	17
NMSU 515	515												
New Mexico	13723919	70 -7	633	86	622 75	3.07	.17	410 ¹	-31	1180	40	460	3
Advance Prince 117D	117D												
Utah	14454199	100 21.5	475	73	457 35	2.92	.35	23.18 ²	2.15	849	62	364	-2
Reno 737E	787												
Reno, Nev.	13201722		515	35	519 22	2.16	.17	21.2 ²	.5	823	63	391	3
KC E458	458												
Knoll Creek, Nev.	13201745		540	138	511 105	1.43	.19	18.0 ²	-.4	752	174	401	11
Royal 6498	6498												
Colorado	14130046		525	167	563 79	3.01	.28	6.67 ³	-.45	1005	132	375	5
Brae Arden 5642	5642												
Colorado	13671428		265	-163	401 -94	3.15	.25	140	0	903	-62	335	-24
Gillette Arden 86													
Wyoming	10478981	82 3.4	430	44	407 34	2.44	-.23	168	0	880	51	373	6

1Lb. TDN/100 lb. gain - lower value is superior

2Lb. gain/100 lb. TDN - Higher value is superior (Nevada adjusted to a constant initial weight)

³Lb. feed/lb. gain - lower value is superior

Miles City - Adjusted weaning weight to 180 days and 6-year-old dam basis

New Mexico Adjusted to 240 days of age

Utah
Adjusted for age of dam (2-yr.-old dam, add 73 lb.; 3-yr.-old, 53 lb.; 4-yr.-old, 25 lb.)

Adjusted for age of calf and dam

Adjusted to 200 days of age, inbreeding of calf and of dam

Wyoming . . . Adjusted to 180 days

UNIVERSITY OF CALIFORNIA

- I. Station: California Agricultural Experiment Station
- II. Project title: Bovine muscular hypertrophy - a study of its inheritance and an investigation of its usefulness to the beef industry (Project 2477)
- III. Personnel:
- Experiment Station:
W. C. Rollins, Project Leader, L. M. Julian, Moira Tanaka,
and K. A. Wagnon
- U. S. Department of Agriculture, Agricultural Research Service
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress and conclusions to date:

A new trait has been added to the meat index (M.I.) and identification phenotype (I.P.); namely, grading the shape (prominence) of the gluteus medius muscles (see attached I.P. Data Sheet, Rev. 2, 12/8/66). Sighting along the back from a position to the rear of the animal, one grades the gluteus radius shape as shown on the field sheet. Shape 1 is characteristic of the mm animal and 4 of a ++ animal with a relatively small gluteus medius.

The effort to produce mm and m+ animals for study and experimentation, especially those of the British beef breeds, is continuing. When possible, cows judged m+ by progeny test are purchased for the breeding herd. In 1967, the cow herd was bred to two m+ bulls (a black and a red Angus) and one mm red Angus bull. Calving will occur April to July, 1968.

Thirteen steer and 13 heifer calves of a m+ Charolais bull bred to Angus, Hereford, and Shorthorn cows have just been fed out and slaughtered (see attached form for details of data collected). These data will be analyzed for evidence of heterozygous expression and the ability of the I.P. to detect it.

Similar data were collected from five offspring of a ++ Angus bull mated to the same cow herd and from 12 steer and 11 heifer calves of project 1216, all sired by a ++ Angus bull. These groups will be used to further test the accuracy of the meat index (M.I.) and as controls for the I.P. study.

Further M.I. carcass test data, of a somewhat different nature from those described above, are currently being obtained from a progeny

Identification Phenotype (IP)
Variation in Thigh Creases and Rump Shape

Rev. 2
 12/8/66

A. Creases in thigh:

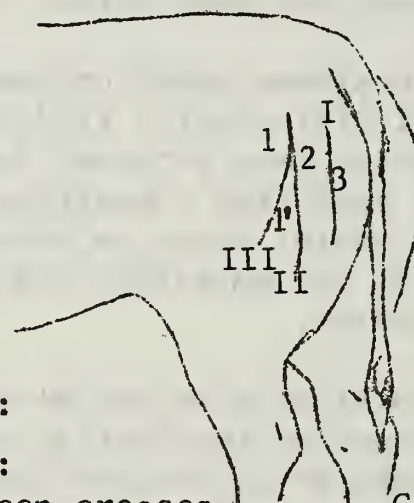
VISIBILITY

	Standing			Moving		
	I	II	III	I	II	III
<u>None</u> : No crease is visible						
<u>Slight</u> : Crease can be seen only by the careful observance of one familiar with the study						
<u>Definite</u> : Crease can be seen easily by one familiar with the study, but is not marked.						
<u>Marked</u> : Crease is markedly noticeable even to one unfamiliar with cattle.						

Relation of condition of coat to visibility of creases:

- _____ Obstructs
 _____ Partially obstructs
 _____ Does not obstruct

Creases I, II, and III



1. M. biceps femoris
2. M. semi-tendinosus
3. M. semi-membranosus

B. Skin thickness (double fold):

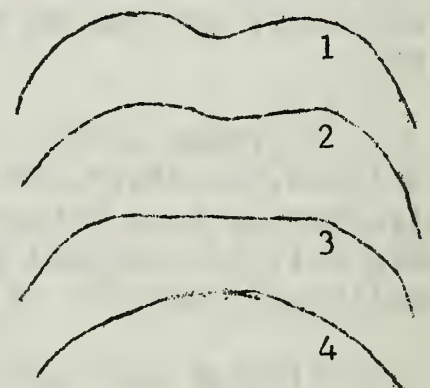
RIB
 (over last rib
 1/3 way down from
 middorsal line)

THIGH:
 (between creases
 I and II)

Gluteus Medius

_____ mm.

_____ mm.



C. Rump (side view):

GRADE:

1 2 3 4 fits none

Date _____ Observer _____
 Animal No. and Sex _____ Breed _____
 Owner _____

Bovine Slaughter and Dissection Data

Project 2477

Slaughter group _____ Slaughter date _____
Animal number _____ Sex _____ Breed _____
Dam _____ Sire _____ Birth date _____
Project _____ Anatomy number _____
Remarks _____

Slaughter Date (fresh weights)

Intact weight _____ Method and time of kill _____
Weight of blood (hot)** _____ Weight of sample _____
Hot weight, right side _____ Left side _____
Hide weight _____ Head and tail weight _____
Weight, four feet _____ Weight, right rear foot _____
Weight, digestive tract full _____ Empty _____
Fill _____ Fluids lost _____
Weight, other offal* _____ Remarks _____

Dissection Data, Right Side (chilled weights)

Date and time _____ Rib eye area _____ Fat thickness _____
Chilled weight in air _____ In H₂O, front _____ hind _____
Specific gravity _____ Hours chill _____
Weight right rear foot _____ Weight right metatarsal _____
Height rear foot _____ Length right metatarsal _____ Wd. _____
WEIGHTS: extensor digitalis brevis _____ semitendinosus _____
semimembranosus, plus add. factors _____ biceps femoris _____
long digital extensor _____ gastrocnemius _____
Femur, weight _____ length _____ width _____
Remarks The triceps brachii is also being dissected.

Bag 1: hide
Bag 2: head, feet, and tail
Bag 3: other offal
Bag 4: digestive tract

*Other offal includes: mesentery, heart, liver, pancreas, spleen,
pulmonary tree.

**Includes sample.

NOTE: SPECIFY UNITS ON ALL WEIGHTS!!! INDICATE TARE, IF ANY, AND UNITS!

test being conducted at Davis by the Extension Service. These data are being collected from 40 bull, steer, and heifer calves of Hereford breeding.

VI. Application of findings:

Too early to report

VII. Work planned for the future:

To continue along the lines described above.

VIII. Publications and manuscripts:

Rollins, W. C., L. M. Julian and F. D. Carroll. 1968. Double muscle segregants in an inbred line of Aberdeen Angus cattle. Submitted to the XII International Congress of Genetics, Tokyo.

Rollins, W. C., L. M. Julian and F. D. Carroll. 1968. A note on the body composition of a double muscled female and a normal female from a linebred Aberdeen Angus herd. Submitted to Animal Production.

IX. Project summary:

California Agricultural Experiment Station

Cattle Inventory

	Calves			Yearlings			Two years over two years		
	Bull	Steer	Female	Bull	Steer	Female	Bull	Steer	Female
<u>++</u>									
BA	1		1		2	1			32
(BA)H									1
(BA)S									1
H									11
(RA)H					3	1			
(RA)S					1				
S									8
<u>+m*</u>									
BA							1		4
H									1
RA							1**		
<u>mm</u>									
BA			1	2	1	1			
(BA)(H)									1
C				1		1			
RA							1		

BA = Black Angus, H = Hereford, S = Shorthorn, RA = Red Angus, C = Charolais. Breed of sire shown first

*On basis of progeny test. **Loan bull.

I. Station: California Agricultural Experiment Station

II. Project title: Studies of heterotic effects in crosses of the Angus, Hereford, and Shorthorn breeds (Project 1216)

III. Personnel:

Experiment Station:

W. C. Rollins, Project Leader, F. D. Carroll, Moira Tanaka,
K. A. Wagnon

IV. and V. Nature and extent of work done this year and summary of progress and conclusions to date:

The experiment proceeded according to plan. At the Sierra Foothill Range, birth of the second calf crop has just been completed and the first calf crop, weaned in July 1967 and brought to Davis for feeding, has just been slaughtered. These data have not yet been summarized.

VI. Application of findings:

The results of this experiment will contribute, along with data gathered and being gathered at other experiment stations in the United States, to precise estimates of the amount of hybrid vigor in crosses of the British beef breeds.

VII. Work planned for the future:

The Sierra Foothill Range phase of the experiment will continue as planned.

VIII. Publications and manuscripts:

None

IX. Project summary:

California Agricultural Experiment Station

Cattle Inventory

	HH	SS	HA	HS	SA	SH	H(HH)	H(HA)	H(HS)
Calves:									
Steers							3	3	
Heifers							3	5	3
2-yr.-old heifers		1			3	2			
3-yr.-old cows	7		8	4					
Bulls		1							

A = Angus, H = Hereford, S = Shorthorn. Breed of sire shown first.

COLORADO STATE UNIVERSITY

- I. Station: Colorado Agricultural Experiment Station
- II. Project title: Study of selection, inbreeding, and the crossing of inbred lines within the Hereford breed (R & M 26)
- III. Personnel:

Experiment Station:

J. S. Brinks, Project Leader, Kent Riddle, Russell Sutton,
and Glenn Richardson

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

- IV. Nature and extent of work done this year:

Much of the work completed during the year dealt with the revision, updating, and additions to record keeping procedures and material. All recorded data are being placed on punch cards in new formats. Calculation of inbreeding coefficients is being done by the computer and 5 of 16 lines have been completed. Most Probable Producing Ability values have been calculated for cows according to the formula:

$$100 + 100 \left[\frac{nr}{1+(n-1)r} \cdot \frac{\sum (\text{cow's record-year average})}{n} \right]$$

where n is the number of calves weaned per cow, r is repeatability (.4), the cow's record is the ratio of her calf's adjusted weaning weight to the adjusted yearly mean, and the year average is set equal to 1.00.

In a recently completed carcass study, the left sides of 116 heifer and 128 bull carcasses from the San Juan Basin herd were used in developing multiple regression prediction equations for carcass cutability. The measures of cutability used were closely trimmed, mostly bone-in steak and roast meat (SRM), which included all steaks and roasts from the round, loin, rib, and chuck; and total freezer meat (FM) yield obtained from the side. Retail cuts were weighted by their relative retail values to determine SRM and FM values. Prediction equations were obtained for eight measures of cutability in each of the two sexes. The equations, shown in tables 1 and 2, indicate that fat thickness at the 12th rib, kidney and pelvic fat weight, longissimus dorsi area, and side weight are somewhat more effective in predicting cutability measured as retail values than as retail cut weights.

In another study using the same carcass data and average daily gain, within sex heritability estimates and genetic correlations were obtained and are presented in table 3. The magnitude of the heritability estimates indicates that substantial progress can be achieved

Regression coefficients for independent variables

Dependent variables	Constant	Fat		Kidney		L.dorsi		Side weight	R ²	Standard error
		thickness	cm.	fat	kg.	area	sq.cm.			
Steak and roast meat:										
SRM weight, kg.	4.325	-2.848		-1.173		-0.01380		0.52650	0.89	2.00
% SRM	51.028	-2.189		-0.955		-0.00858		-0.03911	0.46	1.59
SRM value, dollars	9.933	-5.638		-2.283		-0.01998		1.08384	0.90	4.06
SRM value/kg., dollars	1.082	-0.0430		-0.0185		-0.00008		0.00060	0.46	0.0323
Freezer meat:										
FM weight, kg.	17.012	-4.612		-0.718		-0.07835		0.70154	0.84	3.38
% FM	84.822	-3.503		-0.598		-0.05930		-0.01076	0.44	2.61
FM value, dollars	25.608	-7.585		-1.764		-0.08131		1.28504	0.88	5.28
FM value/kg., dollars	1.498	-0.0574		-0.0145		-0.00056		-0.00013	0.50	0.0403

Table 2. Multiple Regression Prediction Equations for Cutability of Bull Carcasses (14 months)

Regression coefficients for independent variables

Dependent variable	Constant	Fat		Kidney		L.dorsi		Side weight	R ²	Standard error
		thickness	cm.	fat	kg.	area	sq.cm.			
Steak and roast meat:										
SRM weight, kg.	3.513	-2.122		-0.736		0.08141		0.47289	0.96	2.08
% SRM	56.157	-1.766		-0.595		0.06044		-0.04282	0.54	1.66
SRM value, dollars	8.797	-4.235		-1.759		0.19469		0.95451	0.97	3.65
SRM value/kg., dollars	1.177	-0.0360		-0.0140		0.00146		-0.00109	0.67	0.0299
Freezer meat:										
FM weight, kg.	6.897	-5.177		-0.682		-0.05902		0.83130	0.96	3.47
% FM	85.491	-3.687		-0.557		-0.02883		0.01334	0.33	2.57
FM value, dollars	12.072	-8.020		-1.654		0.03469		1.39060	0.98	4.68
FM value/ kg., dollars	1.527	-0.0600		-0.0130		0.00047		-0.00042	0.58	0.0338

through selection for both daily gain and carcass Merit. Direct selection for daily gain alone should also increase carcass merit considerably through correlated response.

Table 3. Genetic Correlations with Average Daily Gain (feedlot period) and Heritability Estimates for Various Beef Cattle Traits

Trait	Genetic correlation	Heritability
Average daily gain	--	0.64
Rib eye	0.68	0.36
Fat thickness	-.75	0.62
Kidney fat weight	-.02	0.40
Marbling score	0.30	0.42
Retail carcass value	0.39	0.70

Preliminary analyses on the effect of the date of the dam's first calving on lifetime production, measured as number of calves and total pounds of weaning weight, have been completed. The data include birth and weaning dates along with weaning ages and weights collected at the San Juan Baisn Station from 1948 through 1967. The data were separated into cows calving first as 2's and those calving first as 3's. These two classifications were further broken down into groups based on date of calving. Group 1 consisted of cows calving the first 20 days of the expected calving season plus cows calving as much as 15 days early due to variation in gestation lengths, or a total period of 35 days. Groups 2 through 5 consisted of subsequent 20-day intervals. In addition, "early" and "late" categories are listed that fell outside the 115-day period.

Table 4 lists the averages by groups described above. Weaning weights of calves from cows calving the first time in Group 1 were the heaviest, being 20 pounds heavier than herd average. There was a steady decline in average weaning weights by group thereafter. The average daily gain of calves shows a similar pattern. The data indicate that

Table 4. Trait Averages Grouped by Season of Birth of Dam's First Calf

Group	Two-year-old at first calf							Three-year-old at first calf						
	Number		Average					Number		Average				
	dams	calves	day of birth	daily gain	weaning weight	weaning age	Per-cent lost	dams	calves	day of birth	daily gain	weaning weight	weaning age	Per-cent lost
Early	4	23	102	1.62	407	209	21.7	2	4	100	0	0	0	100.0
1	38	176	100	1.65	417	211	15.9	74	305	102	1.58	399	208	13.8
2	121	571	104	1.64	409	206	13.5	38	136	104	1.58	397	207	14.7
3	141	705	107	1.59	392	203	11.8	11	30	117	1.54	369	194	20.0
4	92	348	113	1.58	381	197	14.4	5	26	117	1.65	389	193	3.9
5	16	78	117	1.59	377	193	10.3	2	4	143	1.78	367	167	25.0
Late	2	5	168	1.16	266	142	20.0	0	--	--	--	--	--	--
Total or Average	414	1906	107	1.61	397	203	13.2	132	505	104	1.58	396	206	14.7

cows calving early the first time tend to calve earlier thereafter, and that early calving appears to be nearer the optimum for maximum daily gain of calves. This may be due to the right combination of milk production of the dam and milk consumption potential of the calves. Thus, calves from dams calving earlier the first time weigh considerably more at weaning because they are older and also have gained faster.

In a study on factors affecting weaning weights in Hereford cattle from a cooperator's ranch, data on 4770 calves collected from 1958 through 1965 were analyzed. Least-squares analyses of the effects of year, sex, age of dam, season of birth, and the two-way interactions were performed in an over-all analysis, separated by sex, and separately by years. All main effects were highly significant ($P < .01$). Interactions of year $\times$ sex, year $\times$ age of dam, year $\times$ season of birth, and age of dam $\times$ season of birth were highly significant in at least one analysis. Season of birth and all interactions comprised less than one percent of the total variance. Additive correction factors appeared to be more successful for years and seasons, whereas multiplicative factors were more desirable for sex and age of dam, in equalizing both the means and variances.

In another study on data from the same cooperator herd, records from 1551 cows and their 8491 calf records were used to study environmental effects on calving interval. Calving interval was measured as the number of days between consecutive calvings of each dam. Cows in all analyses were born after 1930 and disposed of prior to 1967. The average calving interval and corresponding standard deviation was 381 days and 74 days, respectively. The first analysis included the effects of season and year of birth of cow and number of calves per cow on cow's average calving interval. Only number of calves per cow was significant ($P < .01$) and showed a linear trend, where cows with the most records had the shortest calving interval. A second analysis, using individual calving records corrected for year of birth of calf, included the effects of season of calf, sex of calf, season of dam, type of breeding (pasture, hand, or A.I.), and type of calf (dead, aborted, twin, abnormal, or normal). All effects were significant ($P < .01$) except sex of calf and season of dam.

In addition, records from the same herd on 24,710 calvings by 479 sires and 4531 cows were used to obtain descriptive herd statistics. Type of calf grouped by dead, aborted, and twin categories accounted for 8.1, 1.1, and 1.1 percent, respectively. Groupings by sex of calf yielded 49.8 percent bulls, 48 percent heifers, and 1.3 percent unclassified. Average ages at first calving, last calving, and disposal were 2.8, 7.5, and 8.2 years. The average number of calves per cow was 5.4. Cows producing at least one calf in the twin, dead, or aborted categories accounted for 2.9, 35.0, and 6.0 percent of the total. Calvings during winter, spring, summer, and fall accounted for 7.6, 63.9, 15.4, and 13.1 percent, respectively. Cows disposed of for reason of natural death, salvage, accidental death, or for breeding accounted for 7.8, 61.2, 2.0, and 29.0 percent, respectively.

V. and VI. Summary of progress and application of findings:

Prediction equations developed for bull and heifer carcass cutability based on weights and values account for a large portion of the total variability in cutability and should be useful in selecting superior carcasses. Those based on value were more accurate than those based on weights only.

Selection for increased carcass desirability should be effective since heritability estimates are relatively high and genetic correlations do not indicate any genetic antagonisms between important traits. Selection for daily gain also will improve carcass merit.

It seems clear that an important way of increasing lifetime production of cows is to manage and breed yearling heifers so they will calve early in the optimum season their first time.

VII. Work planned for the future:

A project revision is contemplated with emphasis on comparisons of linecrosses within breeds, versus crossbreeding with outbred parental stock, versus crossbreeding with inbred parental stock. The present work also will be continued along project outlines.

VIII. Publications and manuscripts:

Brinks, J. S. 1968. Field Day Report. Colorado Agricultural Experiment Station General Series 869.

Fagerlin, P. T., J. S. Brinks and H. H. Stonaker. 1968. Environmental effects on calving interval in Herefords. Submitted to Amer. Soc. Anim. Sci., West. Sect. Proc. 19:

Linton, Arthur C. 1967. Factors affecting weaning weights. M. S. Thesis. Colorado State University. Fort Collins.

Linton, A. C., J. S. Brinks, H. H. Stonaker, T. M. Sutherland and L. C. Faulkner. 1968. Factors affecting weaning weights of cattle. Submitted to Amer. Soc. Anim. Sci. West. Sect. Proc. 19:

Richardson, G. L., J. S. Brinks and D. A. Cramer. 1968. Predicting bull carcass cutability as retail values. Submitted to Amer. Soc. Anim. Sci. West. Sect. Proc. 19:

IX. Project summary:

Colorado Agricultural Experiment Station

Cattle Inventory - June 1968					Total
Breed	Hereford		Crossbred		
Line	Inbred	Line-cross	Control	SxA	
Performance test males:					
Summer bulls	19	3	2	1	25
Steers on Coors test		14			14
Herd bulls (12 mo. or over)	21	1	1	0	23
Cows (2 yr. or over)	105	154	16	4	279
Heifers (replacement yearlings)	17	24	0	0	41
Calves - Bulls					100
to June 1 - Heifers					113

Cow Production Data - 1967 calf crop					H(SxA)	Total
Number cows bred to calve:						
As 2-yr.-olds	22	14	0	1		37
At 3 yr. and up	99	141	13	8		261
Number calves from:						
2-yr.-olds - Alive	18	14	0	1		33
- Dead	0	0	0	0		0
3-yr.-olds and up - Alive	74	121	12	4		211
- Dead	2	4	0	1		7
Number of calves weaned	88	132	12	5		237
Percent calf crop - Born ¹	77.7	89.7	92.3	66.7		84.2
- Weaned ²	95.7	97.8	100.0	100.0		97.1

Prewaning Performance - 1967 calf crop					Average ³
Heart girth - Bulls	74.8	78.0	78.5	77.0	76.8
at birth - Heifers	73.9	76.2	77.5	75.0	75.4
Overall average 76.1					
Weaning age - Bulls	197.0	207.2	205.4	229.7	203.6
- Heifers	204.2	204.4	213.5	224.0	205.5
Overall average 204.5					
Weaning weight - Bulls	380.0	476.8	445.0	501.7	440.9
- Heifers	361.3	424.4	449.6	560.0	406.0
Overall average 424.3					
Adjusted weaning weight ⁴ - Bulls	450.0	475.0	452.2	550.7	464.8
- Heifers	437.5	455.7	462.3	530.0	450.5
Overall average 458.0					
Weaning score:					
Conformation ⁵ - Bulls	4.33	4.63	4.57	5.10	4.53
- Heifers	4.33	4.60	4.70	4.90	4.52
Overall average 4.52					
Average inbreeding - Bulls	0.439	0	0	0	0.439
- Heifers	0.413	0	0	0	0.413

Colorado Agricultural Experiment Station

Postweaning Performance - 1967 calf crop					Total or average
Breed	Hereford		Crossbred		
Line	Inbred	Line- cross	Control	SxA	
Sex	Bull	Bull	Bull	Bull	
Method of feeding	Individual				
Number on test	20	44	6	2	72
Average age on test	238.1	237.8	245.5	248.5	238.8
Initial weight	441.0	504.3	460.0	591.0	485.4
Days on test	140	140	140	140	140
Average daily gain	2.61	2.83	2.28	2.49	2.64
Feed efficiency:					
Feed/lb. gain	7.02	6.76	10.07	7.86	7.14
Final weight	805.7	901.0	778.6	940.0	865.4
Final score:					
Conformation	4.82	5.01	4.78	4.80	4.93
Average inbreeding	0.437				

¹Number born/number cows bred

²Number weaned/number born alive

³Weighted averages

⁴Adjusted weaning weight - correction after Harwin Model 3

	Bulls		Heifers	
Inbreeding of dam	add	0.78 lbs.	0.79 lbs.	per 1% inbreeding of dam
Inbreeding of calf	add	0.41 lbs.	0.24 lbs.	per 1% inbreeding of calf
Age of dam:				
2-year-old	add	55.0 lbs.	63.0 lbs.	
3-year-old	add	20.0 lbs.	36.0 lbs.	
4-year-old	add	14.0 lbs.	15.0 lbs.	
5-year-old +		No correction		

⁵Code: 6 = prime, 5 = choice, 4 = good, 3 = medium, 2 = common

UNIVERSITY OF HAWAII

- I. Station: Hawaii Agricultural Experiment Station
- II. Project title: The estimation of genetic and phenotypic parameters in populations of beef cattle in Hawaii and their use in selection programs.
- III. Personnel:
 - Experiment Station:
 - Estel H. Cobb, Project Leader, Isaac I. Iwanaga, Kiyoichi Morita, and Diedrich Reimer
 - Hawaii Ranch Company
 - Tom Liggett
 - Kahua Ranch Company, Ltd.
 - H. M. Richards, Jr.
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

The testing of inbred lines in connection with the Arizona Station was continued during the year. Four lines were used again at Hawaiian Ranch Company. Semen from six of the inbred lines was used at Kahua Ranch Company. Semen from two Washington State Angus bulls was used at Kahua Ranch Company. Preliminary results from last year's breeding indicate a low conception rate under the A.I. program.

The records on progeny testing under two feeding regimes for the first five years were analyzed and significant sire x feeding regime interactions for rib-eye area and specific gravity of the whole carcass suggest that progeny testing of beef cattle for carcass composition should be done under the same feeding regime which is used for the market animals. Considerable discrepancy between the ranking of sires based on progeny tests in the feedlot and on pasture was noted for most traits.

Further results on correlations between specific gravity and various carcass traits indicate highly significant correlation between specific gravity and percent trimmed retail cuts (0.72), weight of kidney fat (-.59), and percentage of trimmed round (0.71). Average daily gain on test was significantly correlated with specific gravity and weight of kidney fat for feedlot steers but not for pasture steers. Specific gravity of the whole carcass, weight of trimmed round, fat

thickness over 12th rib, and weight of kidney fat are all significantly correlated with yield of trimmed retail cuts (pounds) in the carcass when carcass weight is held constant.

In the crossbreeding work, breeding herds will be set up according to the schedule of rotating cows annually among the Hereford, Angus, and Charolais sire groups. Heifers born in 1966 will be included for the first time in the breeding groups. Hereford and Angus heifers will be straightbred; crossbred heifers will be bred to bulls of a third breed. Sires added to the breeding herd this year include two Angus, two Hereford, and two Charolais bulls, all obtained from breeders in Hawaii.

Birth weights for all male calves born to date in 1968 averaged about the same as those born in 1967, but female calves averaged about seven pounds heavier than those born in the previous year. Crossbred calves outweighed the straightbreds by an average of 11 pounds, Hereford and Angus crossbred calves averaged seven pounds heavier, and Charolais-sired calves averaged 15 pounds heavier at birth than the Hereford and Angus straightbreds. Death loss at birth was reduced (3.8 percent vs. 6.2 percent in 1967). Three of the calves lost were straightbreds.

Weaning weights and conformation scores were obtained as scheduled on the 1967 calf crop. Crossbred calves averaged 26 pounds heavier at weaning, Charolais-sired calves averaged 36 pounds heavier, and Hereford x Angus crossbreds were 16 pounds heavier than the Hereford and Angus straightbred calves. Conformation score at weaning was less variable. Straightbred Angus calves scored highest (11.8) and Charolais x Hereford calves scored lowest (11.1).

Thirty-three steer calves were shipped to the Waialeale Research Farm on Oahu shortly after weaning for feedlot and carcass evaluation studies.

VI. Application of findings:

Results to date show that crossbred calves of Hereford, Angus, and Charolais breeding are heavier at birth and at weaning than straightbred Hereford and Angus calves. Calving difficulties and death losses at birth do not appear to be adversely affected by crossbreeding. Conformation score at weaning has not shown significant response to any method of breeding employed.

VII. Work planned for the future:

The crossbreeding work will continue. The testing of inbred lines will be discontinued since the semen will no longer be available. Weaning and postweaning records will be obtained on all calves dropped under the testing program.

VIII. Publications and manuscripts:

Indrieri, Richard J. 1967. Comparison of half-sib performance on pasture and in the feedlot. M. S. Thesis. University of Hawaii. Honolulu.

IX. Project summary:

Hawaii Agricultural Experiment Station

Cattle Inventory - June 1968

Breed	Hereford
Line	Hawaiian Ranch Co.
Grade	Grade
Bulls (12 mo. or over)	106
Cows (2 yr. or over)	345
Heifers (yearlings)	145
Calves - Bulls	155
- Heifers	149

Cow Production Data - 1967 calf crop

Number cows bred to calve:	
At 3 yr. and up	407
Number calves born from:	
3-yr.-olds and up - Alive	313
- Dead	16
Number calves weaned	290
Percent calf crop ¹ - Born	76.9
- Weaned	71.3

Prewaning Performance - 1967 calf crop

Weaning age - Bulls (146)	231
- Heifers (144)	235
Weaning weight - Bulls	470.5
- Heifers	446.9
Adjusted weaning weight ² - Bulls	496.7
- Heifers	469.6
Weaning score:	
Conformation ³ - Bulls	11+
- Heifers	12-

¹Number of cows exposed to the bull and number calves born alive

²Adjusted 240-day weight = $\left(\frac{\text{weaning weight} - 70}{\text{age in days}} \times 240 \right) + 70$

³Based on feeder grades where 17, 16, 15 = Prime; 14, 13, 12 = Choice; 11, 10, 9 = Good, etc.

Hawaii Agricultural Experiment Station

Cattle Inventory - June 1968					Total
Breed	Hereford	Angus	Charolais	Crossbred	
Bulls (12 mo. or over)					
Purebred	4 ¹	4	4 ¹		12
Grade				12	12
Cows (2 yr. or over)					
Grade	59	66	0	26	151
Heifers (yearlings)	8	9	0	35	52
Steers (yearlings) ²	9	3	0	21	33
Calves - Bulls	10	8	0	35	53
- Heifers	6	9	0	35	50

¹Includes 3 Hereford and 2 Charolais bulls on loan

²Steer calves sent to Waialeale, October 1967, for feedlot and pasture trials.

Cow Production Data - 1967 calf crop							Total
Breeding group	HxH	AxA	HxA	AxH	CxH	CxA	
Number cows bred to calve:							
At 3 yr. and up	20	14	17	19	19	17	106
Number calves born - Alive	18	13	12	18	17	13	91
- Dead	0	0	3	0	2	1	6
Number calves weaned	18	13	12	18	17	13	91
Percent calf crop ¹ - Born	90.0	92.8	70.6	94.7	89.5	76.5	85.8
- Weaned	90.0	92.8	70.6	94.7	89.5	76.5	85.8

¹Based on number of cows exposed and number calves born alive.

Prewaning Performance Data - 1967 calf crop						
Breeding group	HxH	AxA	HxA	AxH	CxH	CxA
Birth weights - Bulls	79	72	75	78	91	92
- Heifers	72	64	69	69	80	73
Weaning age - Bulls	231	233	247	242	223	231
- Heifers	239	247	245	246	238	241
Weaning weight - Bulls	467	498	527	497	533	555
- Heifers	451	469	460	475	471	504
Adjusted weaning weight ¹ - Bulls	482	509	514	496	568	573
- Heifers	452	457	452	464	474	502
Conformation score ² - Bulls	11.5	11.3	11.3	11.5	11.4	11.8
- Heifers	11.4	11.9	11.4	12.0	11.1	11.8

¹Adjusted 240-day weight = weaning weight + ADG (240 - weaning age)

²Based on feeder grades where 17-15 = Prime; 14-13 = Choice; 11-9 = Good, etc.

Hawaii Agricultural Experiment Station

Postweaning Performance - 1956 calf crop

	AXH	AXA	HXH	HXA	CXH	CXA
Breeding group	4	3	4	2	2	1
Number of steers	663.0	568.0	640.8	648.0	641.0	637.0
Initial weight - lbs.	1005.8	1035.7	1023.2	1032.5	1014.5	1016.0
Final weight - lbs.	2.33	1.84	2.28	2.00	2.30	1.75
Average daily gain	19.5	20.7	19.5	20.5	18.5	18.0
Slaughter grade	19.0	20.7	19.0	19.5	19.5	20.0
Carcass grade	12.1	12.0	10.8	10.2	10.2	10.7
Rib-eye area - sq. in.	63.0	59.1	62.7	61.0	64.3	63.8
Trimmed retail cuts - %	1.0551	1.0382	1.0557	1.0485	1.0684	1.0555
Specific gravity						

UNIVERSITY OF IDAHO

- I. Station: Idaho Agricultural Experiment Station
- II. Project title: The improvement of economically important traits in beef cattle with special emphasis on fertility and carcass quality
- III. Personnel:
 - Experiment Station:
 - R. E. Christian, Project Leader, T. D. Bell, Morris Hemstrom, L. E. Orme, C. W. Hodgson, and S. E. Slyter
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress and conclusions to date:

The progeny testing phase of the project is being confirmed as outlined. The first group of calves from six bulls (two Hereford, two Angus, and two Shorthorn) leased to one commercial cattleman have been placed in the feedlot and will be slaughtered this summer. The other cooperator is using six University Hereford bulls in his commercial Hereford herd. The first calves will be born this spring and will be placed in the feedlot this fall.

Preliminary work is under way to determine if there are sire differences in the rate of attainment of physiological maturity. This year, 18 calves from two Hereford sires are being fed out. Individual calves will be slaughtered at 50-day intervals from 300 to 500 days of age. The first calves will be slaughtered in April.

Work is continuing on the study of the genetic base of fertility. It has been determined that fertility at succeeding services closely approximates the geometric distribution. Eight additional studies reported in the literature, in which fertility at first through fourth services was reported or could be calculated, have been utilized. In most cases it is possible to describe the fertility pattern at succeeding services if the percentage conception at first service is known. This study is being continued.

The study to determine the effect on the progeny test of varying the number of observations according to the level of performance has been initiated. Attempts are being made to synthesize a population on the computer to use in this study.

VI. Application of findings:

An accurate description of the fertility pattern in cattle is necessary for the most efficient management procedures. The demonstration that fertility follows the geometric distribution should be of value to the breeder in predicting the breeding pattern in his herd.

VII. Work planned for the future:

The study of genetic differences in the case of physiological maturity will be continued. The offspring of the six bulls leased to one cooperator will be used this year to gain information in the pattern of attainment of physiological maturity.

The other studies on the genetic basis of fertility and cross breeding for beef production will continue.

VIII. Publications and manuscripts:

None.

IX. Project summary:

Idaho Agricultural Experiment Station

Cattle Inventory - June 1968				Total
Breed	Hereford	Angus	Shorthorn	
Purebred or grade		Purebred		
Bulls (12 mo. or over)	12	4	7	23
Cows (2 yr. or over)	45	28	25	98
Heifers (yearlings)	9	4	4	17
Calves - Bulls	23	15	5	44
- Heifers	25	10	14	49

Idaho Agricultural Experiment Station

Cow Production Data - 1967 calf crop				Total
Breed	Hereford	Angus	Shorthorn	
Purebred or grade		Purebred		
Number cows bred to calve:				
As 2-yr.-olds	9	4	3	16
At 3 yr. and up	44	23	21	88
Number calves born from:				
2-yr.-olds - Alive	8	4	2	14
- Dead	0	0	1	1
3 yr. and up - Alive	42	22	19	83
- Dead	0	0	1	1
Number calves weaned	45	25	19	89
Percent calf crop ¹ - Born	94.3	96.3	87.5	93.3
- Weaned	84.9	92.6	79.2	85.6

¹Calves born alive and calves weaned to cows exposed

Prewaning Performance - 1967 calf crop				
Birth weight - Bulls	76.2	63.7	73.0	71.5
- Heifers	70.0	57.6	62.8	65.4
Weaning age - Bulls	187.3	209.8	198.4	196.7
- Heifers	186.9	220.8	198.8	197.4
Weaning weight - Bulls	351.8	400.4	390.4	373.9
- Heifers	305.1	365.9	336.1	326.9
Adjusted weaning - Bulls	377.1	392.1	398.6	385.0
weight ² - Heifers	327.9	345.1	340.8	335.3
Weaning score:				
Conformation - Bulls	11.3	11.6	11.2	11.4
- Heifers	10.9	10.7	11.1	10.9

²Adjusted to 205 days

Postweaning Performance - 1967 calf crop				
Sex	Bull	Bull	Bull	
Method of feeding		Individual		
Number on test	4	6	2	12
Average age on test	254.5	270.5	280.0	266.9
Initial weight	438.0	494.0	547.5	484.2
Initial score:				
Conformation	12.2	11.7	12.0	11.9
Days on test	112	112	112	112
Average daily gain	2.28	2.02	1.98	2.10
Feed efficiency:				
TDN/100 lb. gain	400.4	508.5	546.2	475.3
Final weight	690.8	720.5	768.5	718.6
Final score:				
Conformation	12.5	11.3	12.5	11.9

MONTANA STATE UNIVERSITY

- I. Station: Montana Agricultural Experiment Station
- II. Project titles: 1. Recurrent selection and record of performance in open and closed beef cattle herds. 2. The genetics of certain protein components in milk from beef cows.
- III. Personnel:
- Experiment Station:
R. L. Blackwell, Project Leader, F. S. Willson, A. E. Flower, Claude Windecker, and J. R. Dynes
- U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

An extensive study of carcass and production data is under way. This involves data collected on the recurrent selection project at Havre from approximately 450 steers produced by linecrosses and approximately 300 steers from topcrosses of station bulls on cooperator herds, and some industry cattle.

A tabulation of gains made by steers from various sources compared to experiment station cattle was made. The results are shown in table 1.

Table 1. Comparison of Various Groups of Cattle with Station Linecross Cattle

Source of cattle	Number	Initial weight	Final weight ^a	Daily gain	Days fed
Cooperator	150	416	951	2.10	252
State bulls x cooperator cows	120	425	993	2.22	250
Stockyards	48	425	976	2.00	277
Havre crosslines	281	439	1011	2.34	242

^aAll steers fed to 1050 pounds or choice grade

Laboratory analyses of the protein fractions of milk samples obtained in 1966 from cows at the U. S. Range Livestock Experiment Station are completed. Other sampling was done in 1967. These samples are being processed in the laboratory now. Only a preliminary study of the 1966 data has been made. No genetic analysis has been attempted. A tabulation of the frequency of the various protein types of breeding groups is shown in table 2.

The frequency of Alpha_{s1}A was very low, being zero in most cases. Alpha_{s1}B was present in nearly all samples, and Alpha_{s1}C varied from zero to 33 percent.

Beta A had a high frequency in all groups (83.3 to 100 percent). Beta B had highly variable frequencies between groups. Beta C was detected in only one group, the Angus x Brown Swiss cross.

Kappa casein had more variability of occurrence between groups than either the Alpha or Beta caseins. Kappa A occurred more frequently than Kappa B, and both occurred together at variable frequencies of 23 to 83 percent in the various breeding groups.

Interest developed in the use of the domestic chicken and the Japanese quail and possibly other laboratory species to study mating systems and selection response. A project was developed and is under way. Selection criterion in birds is egg mass (number times weight) per unit body weight. The mating system is one of alternating inbreeding (full sib matings) one generation with outbreeding (unrelated within the population) the next generation. An unselected random mated control population is maintained for each species.

VI. Application of findings:

From the data in table 1, it appears that the Experiment Station cattle are larger and gain more rapidly in the feedlot than the sample of commercial cattle studied. Station bulls mated to commercial cattle tended to increase their growth rate and final weight. We do not know whether this difference is the result of the selection program, i. e., there are no comparable data at the beginning of the project.

The usefulness of findings on the milk protein study is unclear; however, it should provide additional basic information on the similarities and differences of beef cattle.

VII. Work planned for next year:

Complete the milk protein study. Continue the crossing of the five lines of cattle at Havre. Analyze as thoroughly as time will permit the data collected to date on the project.

VIII. Publications:

Anderson, D. C. 1968. Some factors affecting calf losses. Beef Cattle Field Day. U. S. Range Livestock Experiment Station. pp. 40-44.

Blackwell, R. L. 1968. Genetic aspects of protein components in milk of beef cows. Beef Cattle Field Day. U. S. Range Livestock Experiment Station. pp. 24-26.

IX Project Summary:

Montana Agricultural Experiment Station

Bozeman

Cattle Inventory - June 1968

Breed	Hereford	Angus
Line	Havre	Purebred
Purebred or grade		
Bulls (12 mo. or over)		15
Cows (2 yr. or over)	35	52
Heifers (yearlings)		12
Calves - Bulls	13	27
- Heifers	15	23

Cow Production Data - 1967 calf crop

Number cows bred to calve:	
As 2-yr.-olds	12
At 3 yr. and up	35
Number calves born from:	
2-yr.-olds - Alive	10
- Dead	2
3-yr.-olds and up - Alive	33
- Dead	2
Number calves weaned	42
Percent calf crop ¹ - Born	90.38
- Weaned	80.77

Preweaning Performance - 1967 calf crop

Birth weight - Bulls	68.38
- Heifers	63.86
Weaning age - Bulls	202.41
- Heifers	202.71
Weaning weight - Bulls	466.07
- Heifers	447.14
Adjusted weaning - Bulls	494.0
weight ² - Heifers	465.0
Weaning score: Conformation - Bulls	80.0
- Heifers	81.1

Postweaning Performance - 1967 calf crop

Breed	Angus	Angus
Sex	Bulls	Heifers
Method of feeding	Group	Group
Number on test	26	12
Average age on test	233	237
Initial weight	581	447
Initial score: Conformation	80	81
Days on test	140	140
Average daily gain	2.52	1.41
Feed efficiency: - Grain	733	
Feed/100 lb.gain - Hay	160	
- Total	893	
Final weight	938	645
Final score - Conformation	82	81

Montana Agricultural Experiment Station

North Montana Branch Station - Havre

Cattle Inventory - June 1968

Breed	Hereford
Bulls (12 mo. or over)	74
Cows (2 yr. or over)	278
Heifers (yearlings)	62
Steers (yearlings)	29
Calves - Bulls	102
Heifers	124

Cow Production Data - 1967 calf crop

Number cows bred to calve:	
As 2-yr.-olds	29
At 3 yr. and up	234
Number calves born from:	
2-yr.-olds - Alive	14
- Dead	4
3-yr.-olds and up - Alive	161
- Dead	10
Number calves weaned	175
Percent calf crop ¹ - Born	71.9
- Weaned	66.5

Preweaning Performance - 1967 calf crop

Birth weight - Bulls	83
- Heifers	77
Weaning age - Bulls	178
- Heifers	184
Weaning weight - Bulls	402
- Heifers	400
Adjusted weaning - Bulls	404
weight ³ : - Heifers	393
Weaning score: Conformation - Bulls	80
- Heifers	81

¹ $\frac{\text{Calves born}}{\text{Cows exposed}} = \% \text{ calf crop born}$ $\frac{\text{Calves weaned}}{\text{Cows exposed}} = \% \text{ calves weaned}$

²Adjusted to 205 days and age of dam

³Adjusted to 180 days and age of dam

Montana Agricultural Experiment Station

North Montana Branch Station - Havre

Postweaning Performance - 1966 calf crop

Breed	Hereford			
Line	HL 1	HL 2	HL 3	HL 4
Sire	24	924	967	1124
Sex	Bulls			
Method of feeding	Group			
Number on test	10	7	7	1
Average age on test	178	170	171	166
Initial weight	455	463	512	516
Initial score:				
Conformation	74	78	77	82
Days on test	168	168	168	168
Average daily gain	2.35	2.35	2.26	2.11
Feed efficiency:				
Feed/100 lb.gain:				
Grain	545	539	564	598
Final weight	851	858	892	871
Final score:				
Conformation	80	82	81	80

Postweaning Performance - 1966 calf crop

Breed	Hereford					
Line	HL 1	HL 1	HL 1	HL 2	HL 2	HL 2
Sire	24	226	270	265	280	924
Sex	Steers					
Method of feeding	Group					
Number on test	4	2	6	8	9	4
Average age on test	187	184	170	174	169	166
Initial weight	404	461	455	445	457	279
Initial score:						
Conformation	74	80	79	81	78	69
Days on test	311	266	275	278	276	310
Average daily gain	1.91	2.17	2.10	2.15	2.15	2.08
Feed efficiency:						
Feed/100 lb. gain:						
Grain	707	648	653	624	638	590
Hay	140	141	140	135	138	122
Total	847	789	793	759	776	712
Final weight	998	1036	1030	1042	1048	923

Montana Agricultural Experiment Station

North Montana Branch Station

Postweaning Performance - 1966 calf crop

Breed	Hereford					
Line)	HL 3	HL 3	MC L1	Rancher	Rancher	Stock-
or breeding				IX x	IX x	yards
Sire)	207	250	1124	HL 1	Rancher IX	calves
Sex	Steers					
Method of feeding	Group					
Number on test	7	9	1	5	6	29
Average age on test	175	182	166			
Initial weight	448	458	339	350	421	418
Initial score:						
Conformation	80	80	71			
Days on test	282	272	316	302	294	276
Average daily gain	2.16	2.20	1.78	2.04	1.97	2.00
Feed efficiency:						
Feed/100 lb. gain:						
Grain	641	619	746	642	670	657
Hay	135	135	147	132	140	111
Total	776	754	893	774	810	768
Final weight	1055	1055	900	965	998	970

Postweaning Performance - 1966 calf crop

Breed	Hereford					
Line	HL 1	HL 1	HL 1	HL 2	HL 2	HL 2
Sire	24	226	270	265	280	924
Sex	Heifers					
Method of feeding	Group					
Number on test	12	8	5	6	4	15
Average age on test	183	177	180	177	178	161
Initial weight	426	496	502	479	510	413
Initial score:						
Conformation	73	80	79	81	84	77
Days on test	140	140	140	140	140	140
Average daily gain	1.07	1.22	1.10	1.19	1.02	1.00
Feed efficiency:						
Feed/100 lb. gain:						
Grain	187	164	182	168	196	200
Hay	827	726	806	743	868	886
Total	1014	890	988	911	1064	1086
Final weight	576	667	656	646	653	553
Final score:						
Conformation	83					82

Montana Agricultural Experiment Station

North Montana Branch Station - Havre

Postweaning Performance - 1966 calf crop

Breed	Hereford			
Line	HL 3	HL 3	HL 3	MC
Sire	207	250	967	Control
Sex	Heifers			
Method of feeding	Group			
Number on test	9	5	9	10
Average age on test	174	164	172	158
Initial weight	434	452	433	413
Initial score:				
Conformation	77	79	76	75
Days on test	140	140	140	140
Average daily gain	1.14	1.24	0.97	1.19
Feed efficiency:				
Feed/100 lb. gain:				
Grain	175	161	206	169
Hay	776	713	912	747
Total	951	874	1118	916
Final weight	594	626	569	579
Final score:				
Conformation			81	84

UNITED STATES RANGE LIVESTOCK EXPERIMENT STATION

- I. Station. U. S. Range Livestock Experiment Station, Miles City, Montana
 - II. Project titles: 1. Breed crossing for increased production in beef cattle. 2. Development of superior lines of beef cattle. 3. A study of response to selection and genetic-environmental interaction in genetically similar groups of Hereford cattle at two locations.
 - III. Personnel:
 - U. S. Range Livestock Experiment Station, Miles City, Montana
O. F. Pahnish, Project Leader, J. J. Urick, R. A. Bellows,
R. E. Short, T. M. Riley, R. B. Gibson, D. C. Anderson,
and D. O. Elliott
 - Montana Agricultural Experiment Station, Bozeman, Montana
R. L. Blackwell, F. S. Willson, A. E. Flower, and
N. A. Jacobsen
 - U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- Cooperators:
- U. S. Department of Agriculture, Agricultural Research Service,
Beltsville, Maryland
E. J. Warwick, Acting Assistant Director, Animal Husbandry
Research Division
 - P. A. Putnam, Acting Chief, Beef Cattle Research Branch
 - W. C. Burns, Superintendent, West Central Florida Experiment
Station, Brooksville, Florida
 - Florida Agricultural Experiment Station, Gainesville
Marvin Koger
- IV. and V. Nature and extent of work done this year with summary of
progress and conclusions:

Breed Crossing for Increased Production: Phase 1:

Calves produced in this phase were first crosses of the Hereford, Angus, and Charolais breeds. Bulls of the three beef breeds were also mated to Brown Swiss females as an addition to the main study. Estimation of heterosis in two-breed crosses was the primary objective of

this phase. Results to weaning were summarized in the last W-1 report. The manuscript covering these data is undergoing review.

Postweaning data from phase 1 are being evaluated. Data collection for phase 1 is completed.

Phase 2:

This phase of the crossbreeding study was designed to evaluate maternal qualities of crossbred females (two-breed crosses of the Hereford, Angus, and Charolais breeds). Data through weaning have been collected on the third and final calf crop for this phase. While data through weaning are of major interest, postweaning performance data are being collected, also.

Only in the third calf crop was a maternal advantage of appreciable size indicated for crossbred females by 180-day weights (see project summary). In this final calf crop, the advantage shown by progeny of crossbred dams over progeny of straightbred dams was 31 pounds and 18 pounds for steer and heifer progeny, respectively. Contrary to the calving data on the first two calf crops, however, the calving percentages computed at birth and weaning on the final crop of calves were in favor of straightbred dams.

Crossbred dams obtained by mating Brown Swiss females to Hereford, Angus, and Charolais bulls showed an inconsistent maternal advantage over both straightbred and crossbred dams of the beef breeds, as indicated by 180-day weights. Steer progeny of these crossbred dams exceeded the steer progeny of straightbred dams of the beef breeds by 26 pounds. They were slightly lighter than steer progeny of crossbred dams of the beef breeds. Heifer progeny of the Brown Swiss crossbred dams exceeded the progeny of the straightbred and crossbred dams of the beef breeds by 55 and 47 pounds, respectively. Both steer and heifer progeny of Brown Swiss crossbred dams exceeded the weaning weights of progeny of the other crossbred and straightbred groups in the first two calf crops. The calving percentages of the Brown Swiss crossbred females compared much more favorably with the straightbred and crossbred females of the beef breeds in the second and third years of the study than in the initial year.

Phase 3:

The primary purpose of this phase is to estimate the amount of hybrid vigor that can be realized and maintained through two-way and three-way rotational crossing of the Hereford, Angus, and Charolais breeds. In addition, a synthetic variety is being formed from the three beef breeds, and the Brown Swiss crossbred females initially used in phase 2 are being used as an addition to the main study. Two crops of calves have been obtained to date for most breeding groups (1966 and 1967). Calves of synthetic variety matings were first dropped in 1967. A random half of the male calves of each breeding group are castrated at the end of the calving season.

Data on this phase of the study are still meager. Weaning data for the second year are shown in the project summary. Over the two-year period, the three-breed crosses of the beef breeds seemingly showed some advantage over the two-breed crosses and straightbreds in 180-day weight, although there were year to year inconsistencies. Averaged over years, male calves of the two-breed rotational cross showed some advantage over the straightbreds, but the heifer calves from this crossing system showed essentially no advantage over the straightbreds.

Calves from the Brown Swiss crossbred females, produced by mating first cross females to straightbred beef bulls used in the main study, were heavier than calves produced under any other mating system. Presumably, milk production contributed by the Brown Swiss breeding was an influencing factor.

The synthetic variety, progeny of a (CxH) bull used on two-breed cross females, exceeded the straightbred progeny of the beef breeds in 180-day weight, but comparisons with the two-way and three-way rotational crosses were inconsistent for bull, steer, and heifer calves.

Development of Superior Lines of Beef Cattle:

Development of Inbred Lines:

A test of progress made in selection of Line 1 cattle was started in the breeding season of 1965. This study was described in the previous annual report, where information on the first crop of calves through weaning was summarized. Consistent with results on the 1966 calves, the 1967 calves by bulls born from 1961 to 1963 were heavier at 180 days than calves by bulls born from 1953 to 1955. Weaning scores of calves by the more recent bulls were equal to or better than scores of calves by the earlier sires over the two-year period.

Selection for Carcass Traits:

This study is continuing according to the project outline.

Crossline Study: Phase 1:

This phase of the study was designed to measure hybrid vigor in two-line crosses involving Hereford Lines 1, 4, 6, 9, and 10. Data collection is completed. Results through weaning have been published and a manuscript covering postweaning traits in the live animals is in press.

Crossline Study: Phase 2:

This study was designed to compare the maternal qualities of the crossline and straightline dams. Three calf crops have been produced in this study, and the fourth and final group of calves will be dropped in 1968. Too few calves were produced in the first year to make any valid comparisons. More calves were obtained from both types of dams in the following two years, which were averaged and the results are shown in table 1.

Table 1. Calf Records of Straightline and Linecross Dams
(1966 and 1967 calves)

	Heifers				Bulls			
	Calves	Birth wt.	Weaning wt. ¹	Weaning score	Calves	Birth wt.	Weaning wt. ¹	Weaning score
	no.	lb.	lb.	%	no.	lb.	lb.	%
Linecross ²	83	73.5	344.5	79.0	91	78.5	368.0	80.0
Straightline ²	13	72.5	335.0	79.0	15	77.5	354.5	78.5
Difference		1.0	9.5	0		1.0	13.5	1.5
% advantage		1.4	2.8	0		1.3	3.8	1.9

¹Adjusted to 180 days of age

²The straightlines represent Lines 1, 4, 6, 9, and 10; the crosslines are the result of crossing these straightlines in all possible combinations.

From these preliminary results as shown in table 1, the bull and heifer offspring weighed 13.5 and 9.5 pounds more, respectively, from the crossline dams than from the straightline dams. Thus, the bull calves benefitted slightly more than the heifers as the result of being on the crossline dams. These results compare somewhat favorably with those from the crossbreeding study where the steer calves showed more weaning weight advantage from the crossbred dams than the heifers showed.

Birth weight advantage of both bull and heifer calves from crossline dams amounted to only 1.0 pound, considered to be of little importance, as was the case for weaning scores where only the bulls showed a small advantage (1.5 percentage points) from crossline dams.

Crossline Study: Phase 3:

This study, a follow-up of the phase 2 linecrossing, was designed to compare straightbreds with two-way and three-way linecrosses and with a synthetic variety. One calf crop from this study was produced in 1967 representing all matings except for the synthetic variety, which will produce calves in 1968 for the first time.

Preliminary results from this study can be observed in the report summary. When averaging both heifers and bulls together for all matings, the two- and three-way crosses produced calves weighing 19.0 and 40.5 pounds more, respectively, than those from all straightbreds. These advantages were reflected in weaning scores for both two- and three-way crosses, but only for two-way cross calves in case of birth weights.

The three-way calves appeared very favorable in weaning weights and scores, but were also quite impressive at weaning because of the uniformity they displayed.

Genetic-Environmental Interaction Study:

This project is continuing at the Miles City Station and at the Brooksville Station in Florida according to the long-range plan. At the Miles City Station cattle of Miles City origin continue to be growthier than cattle of Brooksville origin. Results of the past three years (1965, 1966, and 1967) do indicate a reduction in growth differences as compared to results obtained in 1963 and 1964. This reduction in growth difference is, however, evidenced by heifer calves only.

The data on the 1967 calf crop provided the first comparison of the closed and control groups at the Miles City Station. The closed group is of Miles City origin and is bred as a closed four-sire line at that location. Females of the control group are of the same origin as the closed group and constitute a two-sire line. Sires used in the control group are, again, of the same foundation as the two groups of females described. These sires, however, are produced in a herd of Miles City origin now maintained as a four-sire closed herd at Brooksville, Florida.

The sires of the 1967 control calves at Miles City were sired by bulls produced in the closed herd at Brooksville and selected on performance under the Florida environment. While the number of observations is small, the data in the project summary show no evidence of adaptation problems on the part of calves sired by the first two bulls obtained from Brooksville. Calving percentages in the control group were somewhat higher than in the closed group. Weaning weights (180-day) and weaning scores of control calves were about equal to or better than those of calves from the closed herd.

VI. Application of findings:

Results from the three phases of the crossbreeding and linecrossing studies will contribute to an evaluation of the merits of crossbreeding and shed additional light upon the value and use of inbred lines.

The study of genetic progress thus far tends to show that the methods used in development of the line were effective over the period represented by sires used artificially. Since contemporary calves of all sires were available for comparison, the environmental year differences were eliminated.

The genetic-environmental interaction study will offer a basis for assessing the importance of adaptation or ability of cattle to adapt to environments other than those in which they are selected. This should help to determine whether the present free interchange of sires has any material effect on the level of beef cattle productivity.

VII. Work planned for the future:

Complete the analysis of postweaning data on phase 1 of the crossbreeding study.

Evaluate data from phase 2 of the crossbreeding project.

Evaluate results from the study of genetic progress in Line 1 cattle and continue with a similar study now started for Line 10.

Proceed with a study of the effects of cow size being formulated from existing data.

Continue all other projects according to project plans.

VIII. Publications and manuscripts:

Bellows, R. A. 1968. Range supplement, grass moisture content, and breeding efficiency. U. S. Range Livestock Experiment Station Beef Cattle Field Day. pp. 35-39.

Pahnish, O. F., J. S. Brinks, J. J. Urick, B. W. Knapp and T. M. Riley. 1968. Results from crossing beef x beef and beef x dairy breeds: Calf performance to weaning. J. Anim. Sci. (In press)

Pahnish, O. F. 1968. Adaptation and cattle productivity--progress report. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 1-6.

Pahnish, O. F. 1968. Effects of crossbreeding on postweaning performance. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 14-19.

Pahnish, O. F. 1968. A comparison of weanling calves produced under two systems of crossbreeding--preliminary observations. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 30-34.

Urlick, J. J., J. S. Brinks, O. F. Pahnish, B. W. Kanpp and T. M. Riley. 1968. Heterosis in postweaning traits among lines of Hereford cattle. J. Anim. Sci. 27(21):323-330.

Urlick, J. J. 1968. A comparison of weanling calves produced under two systems of linecrossing--preliminary observations. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 27-29.

Urlick, J. J. 1968. Effects of linecrossing on postweaning performance. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 7-13.

Urlick, J. J. 1968. Maternal effects on weaning weights and grades of calves from crossbred and linecross dams. U. S. Range Livestock Experiment Station. Beef Cattle Field Day. pp. 20-23.

IX. Project Summary:

U. S. Range Livestock Experiment Station

Cattle Inventory - June 1968								
Breed	Hereford							
Line	L1 ¹	L4	L6	L9	L10	L12	L14	Flor- ida
Purebred	Purebred							
Bulls (12 mo. or over)	37	7	5	11	5	9	12	11
Cows (2 yr. or over)	121	19	27	24	23	47	41	50
Heifers (yearlings)	31	7	11	12	6	13	14	15
Calves:								
Bulls	37	4	10	6	5	16	14	14
Heifers	34	5	9	8	5	13	13	24

Cattle Inventory - June 1968								
Breed	Here- ford	Charo- lais	Angus	Here- ford ²	Cross- bred ³	Here- ford	Charo- lais	Angus
Line	Line- cross			Cross- bred		Purchased		
Purebred or grade	Grade	Purebred		Grade	Grade	Purebred		
Bulls (12 mo. or over)	12	3	27	20	5	4	4	
Cows (2 yr. or over)	245	20	87	148				
Heifers (yearlings)	72	9	62	80				
Calves:								
Bulls	75	11	46	69				
Heifers	75	9	50	76				

¹Includes all animals from GEI project

²All linecross animals resulting from crosses of Lines 1, 4, 6, 9, and 10

³All crosses of A, H, C, and BS breeds

U. S. Range Livestock Experiment Station

Cow Production Data - 1967 calf crop

Line or project	L9	L12	L14	AI Sires		Car- cass
				Genetic		
				<u>progress</u>		
				Hereford		
				550,560	1220	Here- ford
Breeding	---- Hereford ----			716	3313	
Number cows bred to calve:						
At 3 yrs. and up	30 ¹	47 ²	47 ³	56 ⁴	37 ⁵	64 ⁶
Number calves born from:						
3-yr.-olds and up - Alive	24	26	36	30	24	39
- Dead	0	0	1	1	0	1
Number calves weaned	22	24	32	28	22	38
Percent calf crop - Born	85.7	68.4	88.1	60.8	68.6	69.0
- Weaned	78.6	63.2	76.2	54.9	62.9	65.5

Preweaning Performance - 1967 calf crop

Birth weight - Bulls	75	96	82	--	--	86
- Steers	--	--	--	86	88	--
- Heifers	73	83	80	85	79	86
Weaning age - Bulls	190	182	181	--	--	179
- Steers	--	--	--	174	174	--
- Heifers	190	190	185	181	175	186
Weaning weight - Bulls	397	423	389	--	--	406
- Steers	--	--	--	377	419	--
- Heifers	365	379	392	384	381	406
Adjusted weaning - Bulls	379	418	388	--	--	408
wt. (180 da.) - Steers	--	--	--	385	430	--
- Heifers	350	363	383	381	389	396
Weaning score:						
Conformation - Bulls	82	81	81	--	--	81
- Steers	--	--	--	79	81	--
- Heifers	81	81	83	81	81	82

¹Two cows sold on 11-1-66. Computed on basis of 28 remaining cows.

²Nine cows sold on 11-1-66. Computed on basis of 38 remaining cows.

³Three cows sold on 11-1-66; two sold on 11-18-66. Computed on basis of 42 remaining cows.

⁴Five cows sold on 11-1-66. Computed on basis of 51 remaining cows.

⁵One cow sold 11-1-66; one sold 11-4-66. Computed on basis of 35 remaining cows.

⁶Six cows sold on 11-1-66. Computed on basis of 58 remaining cows.

U. S. Range Livestock Experiment Station

Cow Production Data - 1967 calf crop

Project	Linecrossing				
	Phase 2		Phase 3		
	Hereford		Hereford		
	Straight- line	Line cross	Straight- line	Two-line cross	Three-line cross
Breeding					
Total cows bred to calve	29	123	103	9	8
Number cows bred to calve:					
As 2-yr.-olds	13	40	--	--	--
At 3 yr. and up	16 ¹	83 ²	103 ³	9	8
Number calves born from:					
2-yr.-olds - Alive	6	32	--	--	--
- Dead	1	0	--	--	--
3-yr.-olds and up - Alive	8	66	71	8	7
- Dead	0	1	4	0	0
Number calves weaned:					
From 2-yr.-olds	6	29	--	--	--
From 3-yr.-olds and up	8	65	67	8	7
Percent calf crop:					
From 2-yr.-olds - Born	53.8	80.0	--	--	--
- Weaned	46.2	72.5	--	--	--
From 3-yr.-olds - Born	53.3	82.7	85.2	88.9	87.5
- Weaned	53.3	80.2	76.1	88.9	87.5

Prewaning Performance - 1967 calf crop

Birth weight - Bulls	80	82	80	84	89
- Heifers	74	77	74	79	73
Weaning age - Bulls	178	186	185	178	181
- Heifers	182	182	187	195	194
Weaning weight- Bulls	381	392	398	421	476
- Heifers	338	358	386	417	409
Adjusted weaning- Bulls	386	381	388	424	473
wt. (180-days) - Heifers	335	355	376	391	385
Weaning score:					
Conformation - Bulls	81	81	82	83	87
- Heifers	80	80	83	85	87

¹One cow sold 11-1-66. Computed on basis of 15 remaining cows.

²One cow missing 11-1-66, presumed dead; one cow sold 11-1-66. Computed on basis of 81 remaining cows.

³Fifteen cows sold 11-1-66. Computed on basis of 88 remaining cows.

U. S. Range Livestock Experiment Station

Cow Production Data - 1967 calf crop			
Project	Crossbreeding		
	Phase 2		
Breeding	Straight-bred dams ¹	Crossbred dams ²	Crossbred dams ³
Number cows bred to calve:			
As 2-yr.-olds	25	39	11
Number calves born from:			
2-yr.-olds - Alive	21	29	9
- Dead	1	0	0
Number calves weaned	20	24	9
Percent calf crop - Born	88.0	74.4	81.8
- Weaned	80.0	61.5	81.8

Preweaning Performance - 1967 calf crop			
Birth weight - Steers	76	76	89
- Heifers	75	74	76
Weaning age - Steers	196	192	197
- Heifers	192	191	190
Weaning weight - Steers	404	430	432
- Heifers	385	402	449
Adjusted weaning - Steers	376	407	402
wt. (180 days) - Heifers	365	383	430
Weaning score:			
Conformation - Steers	81	83	81
- Heifers	81	82	82

¹Straightbred H, A, and C dams

²Dams were two-breed crosses of H, A, and C breeds

³Two-breed crosses of H, A, or C x BS

U. S. Range Livestock Experiment Station

Cow Production Data - 1967 calf crop

Project	Crossbreeding				
	Phase 3				
Breeding	Straight- bred dams ¹	Cross- bred dams ²	Cross- bred dams ²	Cross- bred dams ³	S.V. Cross- bred dams ⁴
Number cows bred to calve:					
At 3 yr. and up	64 ⁵	45 ⁶	37	20	25 ⁷
Number calves born from:					
3-yr.-olds and up - Alive	47	38 ⁸	31 ⁹	17 ³	22
- Dead	0	0	0	1	0
Number calves weaned	47	36	29	17	22
Percent calf crop - Born	78.3	88.4	83.8	90.0	91.7
- Weaned	78.3	83.7	78.4	85.0	91.7

Preweaning Performance - 1967 calf crop

Birth weight - Bulls	88	88	83	93	92
- Steers	80	92	92	92	92
- Heifers	77	77	80	87	85
Weaning age - Bulls	187	190	194	193	188
- Steers	187	190	190	184	190
- Heifers	191	193	193	187	193
Weaning weight - Bulls	450	455	493	516	478
- Steers	403	471	455	453	427
- Heifers	414	418	443	459	424
Adjusted weaning - Bulls	437	436	461	488	462
wt. (180 days) - Steers	391	449	436	445	411
- Heifers	394	395	417	445	401
Weaning score:					
Conformation - Bulls	81	84	86	85	84
- Steers	81	83	83	83	82
- Heifers	81	81	84	84	83

¹Representing H, A, and C breeds.

²Representing two-breed crosses of H, A, and C breeds.

³Two-breed crosses of H, A, or C x BS breeds. Calves represent three-breed cross.

⁴Synthetic Variety representing two-breed crosses of H, A, or C dams bred to C x H sire.

⁵One cow died 10-2-66, three sold on 11-1-66. Computed on basis of 60 remaining cows.

⁶Two cows sold 11-1-66. Computed on basis of 43 remaining cows.

⁷One cow sold 11-1-66. Computed on basis of 24 remaining cows.

⁸Calves were two-breed crosses.

⁹Calves were three-breed crosses

U. S. Range Livestock Experiment Station

Cow Production Data - 1967 calf crop

Project	GEI Study		
		Hereford	
Breeding	Florida	Closed Line 1	Control Line 1
Number cows bred to calve:			
At 3 yrs. and up	43 ¹	62 ²	21 ³
Number calves born from:			
3-yr.-olds and up - Alive	27	43	15
- Dead	1	1	1
Number calves weaned	26	42	14
Percent calf crop - Born	73.7	75.9	88.9
- Weaned	68.4	72.4	77.8

Prewaning Performance - 1967 calf crop

Birth weight - Bulls	84	86	93
- Heifers	71	82	82
Weaning age - Bulls	182	174	180
- Heifers	185	176	183
Weaning weight - Bulls	388	398	403
- Heifers	353	364	406
Adjusted weaning - Bulls	381	409	405
wt. (180 days) - Heifers	347	371	396
Weaning score:			
Conformation - Bulls	82	82	82
- Heifers	81	80	82

¹Four cows sold on 11-1-66, one cow died 12-5-66. Computed on basis of 38 remaining cows.

²Two cows sold on 11-1-66, one cow died on 7-8-66, one died on 10-17-66. Computed on basis of 58 remaining cows.

³Three cows sold on 11-1-66. Computed on basis of 18 remaining cows.

U. S. Range Livestock Experiment Station

Postweaning Performance - 1967 calf crop

Project	Line Development Record of Performance			
	Hereford			
Breed	L 9	L 12	L 14	Carcass
Line	Purebred	Purebred	Purebred	Grade
Purebred or grade				
Sex	Bull			
Method of feeding	Group - Feedlot			
Number on test	9	9	12	15
Average age on test	207	198	193	195
Initial weight	407	442	379	425
Initial score:				
Conformation	82	81	80	81
Days on test	196	196	196	196
Average daily gain	2.43	2.71	2.57	2.66
Final weight	891	974	882	946
Final score:				
Conformation	79	83	79	82

Postweaning Performance - 1967 calf crop

Project	Maternal Study Phase 2				
	Hereford ¹		Crossbreds		
Breed	Linecrossing		Crossbreeding		
Line	By	By	By ²	By ³	By ⁴
	Straight-	Cross-	Straight	Two-breed	Cross-
	line dams	line dams	bred dams	cross dams	bred dams
Sex	Bull	Bull	Steer	Steer	Steer
Method of feeding	Group - Feedlot				
Number on test	6	44	9	9	3
Average age on test	194	202	212	207	213
Initial weight	399	418	442	455	477
Initial score:					
Conformation	81	81	81	82	81
Days on test	196	196	196	196	196
Average daily gain	2.47	2.36	2.64	2.54	2.45
Final weight	884	881	959	954	958
Final score:					
Conformation	78	78			

¹Representing Lines 1, 4, 6, 9, and 10

²Straightbred Hereford, Charolais, and Angus dams

³Dams were two-breed crosses of H, A, and C breeds

⁴Two-breed crosses of H, A, or C x BS

U. S. Range Livestock Experiment Station

Postweaning Performance - 1967 calf crop

Project	Mating Systems Phase 3		
Breed	Hereford		
Line	Linecrossing		
	Straightline dams ¹	Two-way rotation ²	Three-way rotation ²
Sex	Bull		
Method of feeding	Group - Feedlot		
Number on test	30	4	3
Average age on test	201	194	197
Initial weight	412	440	508
Initial score:			
Conformation	82	83	87
Days on test	196	196	196
Average daily gain	2.47	2.28	2.38
Final weight	897	886	974
Final score:			
Conformation	79	79	84

¹Representing Lines 1, 4, 6, and 10

²Linecross dams of Lines 1, 4, 6 and 10 x Straightline 1, 4, 6, and 10 sires

Postweaning Performance - 1967 calf crop

Project	Mating Systems Phase 3				
Breeding	Crossbreds				
Line	Crossbreeding				
	Straight bred ¹	Two-way rotation	Three-way rotation	Three-way ² rotation	Synthetic variety
Sex	Bull				
Method of feeding	Group - Feedlot				
Number on test	11	7	5	5	6
Average age on test	206	206	210	209	203
Initial weight	490	490	528	564	568
Initial score:					
Conformation	81	84	86	85	87
Days on test*	140	140	140	140	140
Average daily gain*	2.95	2.92	2.90	3.17	3.04
140-day weight	903	899	933	1007	994
Final score:					
Conformation*					

*Test not completed. Based on 140 days

¹Representing H, A, and C breeds

²A, C, or H sire x ABS, CBS or HBS dams

U. S. Range Livestock Experiment Station

Postweaning Performance - 1967 calf crop

Project		Mating Systems			
Breeding		Phase 3			
		Crossbreds			
		Crossbreeding			
Line	Straight-bred ¹	Two-way rotation	Three-way rotation	Three-way rotation	Synthetic variety
Sex			Steer		
Method of feeding			Group	Feedlot	
Number on test	11	9	6	4	7
Average age on test	204	205	206	200	205
Initial weight	439	479	509	474	504
Initial score:					
Conformation	81	83	83	83	84
Days on test*	140	140	140	140	140
Average daily gain*	2.51	2.76	2.74	2.73	2.49
140-day weight	790	866	893	856	853
Final score:					
Conformation*					

*Test not completed. Based on 140 days.

¹Representing H, A, and C breeds

²A, C, or H sire x ABS, CBS, or HBS dams

U. S. Range Livestock Experiment Station

Postweaning Performance - 1967 calf crop

Project	Genetic-Environmental Interaction		
	Record of Performance		
Breed	Hereford	Hereford	Hereford
Purebred or grade	Purebred	Purebred	Purebred
Line	Line 1 (Closed)	Line 1 (Control)	Florida
Sex		Bull	
Method of feeding		Group - Feedlot	
Number on test	26	5	10
Average age on test	190	192	197
Initial weight	415	442	403
Initial score:			
Conformation	82	83	82
Days on test	196	196	196
Average daily gain	2.70	2.74	2.34
Final weight	944	979	863
Final score:			
Conformation	80	79	76

Postweaning Performance - 1967 calf crop

Project	Artificial Insemination ¹	
	Hereford	Hereford
Breed	Line 1 sires	Line 1 sires
Line	550,560,716 ²	1220,3313 ³
	Grade dams	Grade dams
Sex		Steer
Method of feeding		Group - Feedlot
Number on test	5	12
Average age on test	189	191
Initial weight	460	410
Initial score:		
Conformation	82	80
Days on test	196	196
Average daily gain	2.49	2.35
Final weight	947	871

¹Estimating genetic gain by use of frozen semen from bulls of different generation intervals

²Sires 550 and 560 born in 1953, sire 716 born in 1955

³Sire 1220 born in 1961, sire 3313 born in 1963

UNIVERSITY OF NEVADA

- I. Station: Nevada Agricultural Experiment Station
- II. Project titles: 1. Interaction between genotype and environment in selection for economically important traits in Hereford cattle. 2. The effect of genetic-environmental interactions on selection responses.
- III. Personnel:
 - Experiment Station:
C. M. Bailey, Project Leader, S. P. Hammack, J. E. Hunter,
and C. R. Torell
 - U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Work done this year and summary of progress:

Selection for single characters was continued in five closed Hereford lines at the Main Station Field Laboratory, Reno, and at the Knoll Creek Field Laboratory near Contact, Nevada. During 1967-68, a total of 116 calves were performance tested at the two locations. Growth rate, feed conversion, and conformation data are reported in the project summary.

S. P. Hammack completed a three-year study of the feed efficiency of young bulls during a post-test fattening period. Each year, half of the bulls in each line was slaughtered at the conclusion of the standard (140-day) postweaning test; the remaining bulls were fed a fattening ration until a live weight of approximately 1000 pounds was attained. Least-squares means of performance and carcass characteristics of line progenies are given in table 1. There were significant ($P < .05$) differences among the Reno lines in percent carcass fat, both initially and at the end of the fattening phase. Line 4 bulls consumed more ($P < .05$) feed per day, gained more weight per day, and were heavier at the time of slaughter than contemporaries in Line 5 which had been tested under similar conditions prior to the fattening period. Within-location differences between lines in other characteristics were nonsignificant. Line differences in measures of feed efficiency (table 2) appeared to be most pronounced when variation in carcass fat content was taken into account.

A fourth pair of sires from the efficiency lines at the two locations (lines 2 and 5) was sent to San Carlos, Arizona, for use in the progeny testing program which is being conducted in cooperation with the U. S. Department of Agriculture, Arizona, Hawaii, and other states in the Western Region.

Table 1. Least-Squares Means of Characteristics of Line Progenies Slaughtered Initially (Group A) or after a Period on a Fattening Ration (Group B)¹

Item	Main Station ²			Knoll Creek ²	
	Line 1	Line 2	Line 3	Line 4	Line 5
Selection criterion	Gain	Eff.	Conf.	Gain	Eff.
Group A:					
Number	18	14	18	13	18
Slaughter age, days	399	397	399	412	405
Slaughter weight, lb.	597	710	717	536	525
Carcass weight, lb.	395	406	410	293	282
Area l.dorsi,sq.in./100 lb.	2.78	2.95	2.90	3.12	3.31
Carcass fat, % ³	15.2	14.8	15.6	9.9	10.3
Group B:					
Number	18	16	18	13	18
Initial weight, lb.	686	714	705	538	527
Days on feed	108	95	96	137	148
Daily gain, lb.	2.90	3.04	3.05	3.42	3.09
Daily TDN consumed, lb.	15.1	15.4	15.5	15.0	14.2
Daily digestible energy, mcal.	32.52	33.10	33.45	32.29	30.58
Slaughter age, days	510	503	496	551	557
Slaughter weight, lb.	994	1003	997	1003	975
Carcass weight, lb.	613	609	611	604	587
Area l.dorsi,sq.in./100 lb.	2.21	2.24	2.22	2.19	2.19
Carcass fat, %	17.4	18.1	20.7	21.0	20.8

¹Data were obtained during 1965, 1966, and 1967.

²Bulls from Lines 1, 2, and 3 received 1 part concentrate:2 parts grass hay prior to the fattening period. Lines 4 and 5 received 3 lb. alfalfa pellets plus grass hay ad libitum prior to the fattening phase.

³Percent carcass fat = 487.5 minus 439.8 x carcass specific gravity.

Table 2. Feed Efficiency of Line Progenies on a Fattening Ration

	Main Station			Knoll Creek	
	Line 1	Line 2	Line 3	Line 4	Line 5
Selection criterion	Gain	Eff.	Conf.	Gain	Eff.
Gain lb./100 lb.feed ¹	13.7	14.1	14.1	16.3	15.6
Carcass gain lb./100 lb.TDN	13.8	13.7	14.0	15.1	14.4
Carcass gain lb./100 lb.TDN above maintenance requirements	22.3	22.3	22.4	23.5	22.9
Carcass energy gain, kcal/mcal DE consumed	86.2	94.0	105.3	119.8	114.4
Kcal carcass energy gain/mcal DE consumed above maintenance req.	133.2	143.8	159.7	177.8	173.2

¹No significant difference between lines at either location. Other measures of efficiency are based on means.

The pilot study dealing with the effect of nutritional stress on selection response was completed. Three lines of rats were maintained on a "regular" diet for six generations; an additional three lines received a mixture consisting of 55 percent regular diet:45 percent cellulose during a six-week postweaning test (28 to 70 days of age). Progenies in two of the lines on each nutritional regimen (Reps. A and B) were selected for rapid growth during the postweaning period. The other lines served as controls. Subsequently, sires from the four lines in which selection had been practiced for rapid growth rate were mated with control dams on the two diets. Two replications were conducted. Unweighted means of postweaning gain of group-fed test progeny (N = 1006) are shown in table 3. Statistical analyses of all data collected during the course of the rat study, including feed consumption and body composition of random groups of test progenies, will be completed in the near future.

Table 3. Unweighted Means of Postweaning Gain (gm.) of Test Progenies According to Sire Line, Dam Line, and Sex¹

Dam line ²	Sire line			
	Selection on regular diet		Selection on restricted diet	
	Rep.A	Rep.B	Rep.A	Rep.B
	♂♂			
Regular diet, control	206.8	210.4	202.8	200.2
Restricted diet, control	156.4	152.4	149.6	146.6
	♀♀			
Regular diet, control	111.6	116.4	105.5	109.0
Restricted diet, control	92.7	87.4	85.4	83.0

¹Postweaning period 28 to 70 days of age. Each value is the unweighted mean of two replications.

²Progeny received the same diet as their dams.

VI. Application of findings:

Large differences have been observed in growth characteristics of calves under the two sets of environments during a period of approximately two generations; however, selection for single characters (140-day test gain, efficiency, or conformation at the end of the 140-day postweaning test) has not caused a clear-cut separation of lines at either location. There is some indication from the post-test fattening trials that selection for conformation has resulted in an increase in the amount of fat in the carcass. Although the two lines under selection at the Knoll Creek Field Laboratory have been similar in performance during the standard 140-day test, bulls in the gain line (Line 4) consumed more feed per day and increased in weight more rapidly during the fattening period than those from the line in which selection was directed toward higher efficiency (Line 5).

Final conclusions concerning the relative effectiveness of various selection criteria under different environments will not be

justified until (1) selection has continued for an additional period, and (2) progenies in all lines have been evaluated at both locations.

VII. Work planned for the future:

The five lines will be continued.

Statistical analyses of data from the small animal study will be completed.

Young bulls from the Reno lines will be evaluated on two energy levels during the post-test period.

VIII. Publications:

Bailey, C. M., J. E. Hunter and C. R. Torell. 1967. Response trends in Hereford lines. J. Anim. Sci. 26:883. (Abstr.)

IX. Project summary:

Nevada Agricultural Experiment Station

Cattle Inventory - June 1968						Total
Breed			Hereford			
Line ¹	1	2	3	4	5	
Purebred or grade			Purebred			
Bulls (12 mos. or over)	6	6	6	6	7	31
Cows (2 yr. or over)	37	39	31	36	36	179
Heifers (yearlings)	10	10	10	10	5	45
Calves - Bulls	16	19	18	15	13	81
- Heifers	16	11	11	11	11	60

¹Lines 1, 2, and 3--irrigated pastures; Lines 4 and 5--range conditions.

Cow Production Data - 1967 calf crop						Total or average
Number cows bred to calve:						
At 3 yr. and up	36	36	35	34	36	177
Number calves born from:						
3-yr.-olds and up - Alive	29	31	27	24	10	121
- Dead	2	3	1	2	2	10
Number calves weaned	27	31	24	23	10	115
Percent calf crop: ²						
Born	81	86	77	71	28 ³	69
Weaned	75	86	69	68	28	65

² $\frac{\text{Calves born alive/weaned}}{\text{Cows exposed to bull}} \times 100$

³One bull's penis was injured during the 1966 breeding season

Prewaning Performance - 1967 calf crop						Average
Weaning age - Bulls	234	232	239	219	222	229
- Heifers	234	230	237	212	223	227
Weaning weight ⁴ - Bulls	411	436	436	380	362	405
- Heifers	402	412	396	335	364	382
Average inbreeding - Bulls	11	9	4	7	4	7
- Heifers	12	5	5	8	4	7

⁴Unadjusted weaning weight

Nevada Agricultural Experiment Station

Postweaning Performance - 1967 calf crop						Total or average
Breed	Hereford					
Line ¹	1	2	3	4	5	
Sex	Bull					
Method of feeding	Individual feedlot					
Number on test	14	17	12	12	5	60
Age on test, days	255	253	260	239	242	250
Initial weight, lb.	402	427	429	395	362	403
Length of test, days	140	140	140	140	140	140
Daily gain, lb.	1.93	1.77	1.77	1.03	1.06	1.51
Gain, lb./100 lb.TDN ²	22.0	21.0	20.9	15.3	15.6	19.2
Final weight, lb.	672	675	677	540	509	615
Final score:						
Conformation ³	83.3	83.5	84.2	83.8	82.6	83.5
Inbreeding, percent	11	9	4	7	4	7

Postweaning Performance - 1967 calf crop						Total or average
Breed	Hereford					
Line ¹	1	2	3	4	5	
Sex	Heifer					
Method of feeding	Individual feedlot					
Number on test	11	14	10	11	5	51
Age on test, days	256	251	258	232	243	248
Initial weight, lb.	404	411	393	349	384	388
Length of test, days	140	140	140	140	140	140
Daily gain, lb.	1.37	1.37	1.26	0.99	1.07	1.21
Gain, lb./100 lb.TDN ²	16.9	16.8	16.0	16.6	16.3	16.5
Final weight, lb.	595	603	570	488	533	558
Final score:						
Conformation ³	84.6	84.6	84.7	84.2	84.0	84.4
Inbreeding, percent	12	5	5	8	4	7

¹Progeny in Lines 1, 2, and 3 received 2 parts grass hay:1 part concentrate. Lines 4 and 5 received 3 lb. alfalfa pellets daily plus grass hay ad libitum.

²Not adjusted for body weight.

³Scores from 100 (outstanding) to 67 (cull).

NEW MEXICO STATE UNIVERSITY

- I. Station: New Mexico Agricultural Experiment Station
- II. Project title: Inheritance of heart defects and evaluation of factors affecting production and anomalous traits in beef cattle.
- III. Personnel:

Experiment Station:
L. A. Holland, Project Leader, A. L. Neumann and E. E. Ray

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

Heart defect study:

Defects were not observed in: (1) two calves posted since the last report; 14 steers ranging in age from 15 to 20 months; and 20 cows culled from the breeding groups. All calves from matings to test the inheritance of the ventricular septal defect and the patent ductus arteriosus have been born.

Data analysis:

Analysis of 999 matings in the purebred Hereford herd revealed that 5.5 percent failed to produce a calf, 2 percent aborted fetuses, 5.7 percent produced dead calves at parturition, 0.7 percent resulted in abnormal calves (hydrocephalic), 3.7 percent of the calves were born alive but died before weaning, and 82.4 percent resulted in live calves at weaning. Males comprised 52.28 percent of the total births and 51.64 percent of the calves at weaning.

Twin births were 2.5 percent of the total number of births. Twenty-five percent of the twin calves were stillborn and only 50 percent survived to weaning.

Age of dam influenced percent calf crop weaned, primarily through a higher percentage of stillbirths among two-year-old cows.

Line of sire did not significantly influence percent calf crop weaned; the percent in the Old Line was 82.8 and in the outcross line was 81.4.

Percentage calf crop at weaning within various levels of inbreeding are shown below:

Inbreed- ing of	Level of Inbreeding						
	.00-.05	.06-.10	.11-.15	.16-.20	.21-.25	.26-.30	.31-.45
Calf	77.1	85.1	86.6	84.2	84.6	79.4	74.6
Sire	82.9	80.0	84.1	82.6	81.0	71.1	--
Dam	83.7	82.9	84.1	82.2	80.7	75.0	70.8

Level of inbreeding did not significantly affect percentage calf crop. However, the lower percentages in the classifications (.26-.30) and (.31-.45) hint that lower percentage calf crop may occur at higher levels of inbreeding. The frequency of matings in these classifications were 144/999 among calves and 68/999 among the dams. The effect of age-of-dam x inbreeding-of-calf interactions on percent calf crop at weaning was nonsignificant.

Data from 79 Hereford steers slaughtered in 1964, 1965, and 1966 were analyzed to determine correlations between live and carcass traits, and among carcass traits. Means and standard deviations are presented in table 1. Simple correlations are shown in table 2 and partial correlations with carcass weight held constant are shown in table 3.

The simple and partial correlations of retail trimmed high priced cuts (lbs. or percent) with loin eye area and fat thickness indicate that these characteristics are not highly related in cattle of this range in slaughter weight. Utilizing carcass weight, loin eye area, and fat thickness in multiple regression analyses accounted for 77 percent of the variation in pounds of retail trimmed high priced cuts but only 17 percent of the variation in percent retail trimmed high priced cuts.

VI. Application of findings:

The ventricular septal defect and the patent ductus arteriosus defect apparently are not inherited, so their occurrence in a breeding herd should not necessitate a change in the breeding program.

Inbreeding up to a level of 30 percent in a herd may not adversely affect calf crop at weaning.

Carcass weight, loin eye area, and fat thickness employed in multiple regression equations are useful as indicators of pounds of retail trimmed high priced cuts but have low predictive value for percent retail trimmed high priced cuts.

VII. Work planned for the future:

Publish study of inheritance of ventricular and ductus arteriosus defects. Revise project with emphasis on crossbreeding Hereford and Brangus cattle.

Table 1. Means and Standard Deviations

Traits	Overall adjusted means	Standard deviations within year lots
Final feedlot weight	913.14	77.95
Slaughter grade	17.02	0.87
Chilled carcass weight	521.25	49.03
Carcass conformation score	20.37	0.70
Carcass final grade	17.65	0.80
Marbling score	12.44	1.65
Retail trimmed high priced cuts - lbs. ¹	88.57	9.03
Retail trimmed high priced cuts - percent ¹	34.60	1.72
Total fat trim - lbs. ¹	29.93	6.82
Total fat trim - percent ¹	11.62	1.98
Loin eye area - sq. in.	9.92	1.18
Fat thickness over rib eye - cm.	1.24	0.43
Shear force value - lbs.	5.59	1.39

¹Right side of carcass

VIII. Publications:

Gosey, James Alex. 1967. Fertility and survivability in two closed lines of Hereford cattle. M. S. Thesis. New Mexico State University. University Park.

Kirkpatrick, Frank David. 1967. The use of certain traits in predicting retail trimmed high priced cuts in beef carcasses. M. S. Thesis. New Mexico State University. University Park.

Table 2. Simple Correlations Between Live and Carcass Characteristics

	Slaughter grade	Carcass weight	Carcass confor- mation	Carcass grade	Marbling score	RTHPC pounds ¹	RTHPC percent ¹	Loin eye area	Fat thick- ness over rib eye	Shear force value	Total fat trim percent	Total fat trim pounds
Final feedlot weight	.594**	.972**	.517**	.298*	.324**	.850**	-.218	.464**	.373**	.056	.484**	.749**
Slaughter grade		.588**	.429**	.438**	.495**	.507**	-.114	.365**	.255*	-.035	.449**	.555**
Carcass weight			.517**	.265*	.303*	.862**	-.239*	.493**	.346**	.062	.496**	.776**
Carcass conformation				.334**	.268*	.518**	.001	.269*	.241*	-.011	.128	.305**
Carcass grade					.818**	.137	-.225	-.020	.080	-.124	.292*	.298*
Marbling score						.173	-.228	.017	.322**	-.099	.412**	.394**
RTHPC pounds							.263*	.548**	.216	.109	.263*	.539**
RTHPC percent								.133	-.286	.129	-.437**	-.439**
Loin eye area									.008	.080	-.023	.175
Fat thickness over rib eye										-.101	.517**	.520**
Shear force value											.107	.102
Total fat trim - percent												.919**

1RTHPC = retail trimmed high priced cuts--closely trimmed bone-in steaks and roasts from rib, loin, rump

*P < .234

**P < .304

Table 3. Partial Correlations Between Carcass Characteristics with Carcass Weight Held Constant

	Carcass grade	Marbling score	RTHPS pounds	RTHPC percent	Loin eye area	Fat thick- ness over rib eye	Shear force value	Total fat trim percent	Total fat trim pounds
Carcass conformation	.238*	.136	.166	.150	.018	.076	-.051	-.174	-.179
Carcass grade		.803**	-.188	-.172	-.180	-.013	-.146	.191	.152
Marbling score			-.183	-.167	-.159	.242*	-.125	.316**	.264*
RTHPC pounds				.954**	.280*	-.174	.109	-.376**	-.408**
RTHPC percent					.298*	-.222	.148	-.377**	-.414**
Loin eye area						-.221	.057	-.355**	-.379**
Fat thickness over rib eye							-.034	.424**	.424**
Shear force value								.087	.085
Total fat trim percent									.976**

*P < .05 = .236

**P < .01 = .307

IX. Project Summary:

New Mexico Agricultural Experiment Station

Cattle Inventory - June 1968				Total
Breed		Hereford		
Line	Old	XL	Linecross ¹	
Purebred or grade		Purebred		
Bulls (12 mo. or older)	5	0	0	5
Cows (2 yr. or over)	37	12	4	61
Heifers (yearling)	17	0	4	21
Calves - Bulls	13	2	1	16
- Heifers	10	1	1	12

¹Linecrosses resulted from mating of Old Line bull with XL cows in the tests for inheritance of the ventricular septal defect.

Cow Production Data - July 1, 1966 to June 30, 1967 calf crop				
Breeding group	Old	XL	Ven- tricular	Ductus arteriosus
Number cows bred to calve:				
As 2-yr.-olds	4			
At 3 yr. and up	11	9	17	13
Number calves born from:				
2-yr.-olds - Alive	3			
- Dead	1			
3-yr.-olds and up - Alive	9	7	13	11
- Dead	2		1	
Number calves weaned	12	6	11	10
Percent calf crop ² - Born	100	77	72	85
- Weaned	80	67	65	77

²Number calves born or weaned/number cows exposed x 100

Prewaning Performance				
Birth weight - Bulls	78	75	84	80
- Heifers	71	67	74	69
Weaning age - Males	240	240	240	240
- Heifers	240	240	240	240
Weaning weight - Bulls	512	486	593	456
- Steers	294		488	
- Heifers	430	430	424	409
Weaning score:				
Conformation - Bulls	6.3	6.6	7.0	5.0
- Steers			6.0	
- Heifers	6.2	7.0	6.0	6.5
Condition - Bulls	11.0	11.4	11.7	10.5
- Steers			11.5	
- Heifers	11.0	11.0	10.5	10.9
Average inbreeding ³ - Bulls	0.33	0.35	0.23	0.35
- Steers	0.30		0.07	
- Heifers	0.28	0.38	0.18	0.45

³Average inbreeding is lower in ventricular septal group because some calves resulted from linecrosses.

OREGON STATE UNIVERSITY

- I. Station: Oregon Agricultural Experiment Station
- II. Project title: Diallel crossing in beef cattle and its use in breed improvement.
- III. Personnel:
 - Experiment Station:
 - Ralph Bogart, Project Leader, W. H. Kennick, K. E. Rowe, Paul Humes, Joe Templeton, Danny Simms
 - U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado
 - Bradford W. Knapp, Acting Investigations Leader
- IV. Nature and extent of work done this year:
 1. Bred cows in the establishment of a synthetic line based on our 1 x 2, 1 x 3, and 2 x 3 bulls and cows. The second crop of calves is starting to arrive. Bred cows in the establishment of a second synthetic line based on our 1 x 2, 1 x 3, and 2 x 3 cows and U. S. Range Livestock Experiment Station 1 x 4, 1 x 10, and 4 x 10 bulls. The second crop of calves is starting to arrive.
 2. Continued the Angus line as a two-sire and 20-cow closed herd.
 3. Completed the gathering of all data on linecross calves produced in the diallel mating. The data have been punched and analyses are underway.
 4. Continued the testing of linecross cows for calf-producing ability by mating them all to one and the same Angus bull.
 5. Completed a study using mice in which selecting for a lowly and a highly heritable trait was practiced under levels of 0, 25, 50, and 100r X-irradiation. The data have been analyzed and most of the material is in manuscript preparation.
 6. Continued the comparison of elite with index selection in flies and mice. Three traits--emergence time, pupa weight, and adult weight--are the traits under selection in houseflies. Litter size, birth weight, weaning weight, and postweaning gains are the traits under selection in mice. The index in each case was constructed from data obtained on the populations prior to the selection studies to develop the genetic parameters, and the economic importance of the traits was based on the assumption that the traits were of equal value.

V. Summary of progress and conclusions to date:

1. Observations of means of the groups in the diallel mating of our three Hereford lines indicate that our Line 1 (Lionheart) shows both high general combining ability and a high specific combining ability with our Line 3 (David). There is approximately twice as much heterosis in heifers as in bulls when linecrosses are compared with their corresponding inbreds.

2. The Angus line (two sires and 20 cows) is continuing to show improvement. Two cows have proved particularly outstanding in that they have produced during a five-year period three outstanding bulls (gains of 3.3 to 3.8 pounds per day, 5 to 5.5 pounds feed per pound gain, and suckling gains of 2.5 pounds per day). Two of these bulls reached 1000 pounds at less than 11 months of age.

3. Mice were selected under different levels of X-irradiation (0, 25, 50, and 100r whole body irradiation prior to mating in each generation). Those receiving 50 and 100r showed a marked decrease in reproductive ability and a high frequency of mammary adenocarcinomas. Ovaries of the females at the fourth generation were almost completely inactive, but no evidence of testicular damage was observed on histological examination.

VI. Application of findings:

1. The general results of our work show that one-sire lines of 15 cows each are too small even when started with a wide genetic base to permit selection effectiveness which will overcome the depressing effects of inbreeding. Indications are that a two-sire line of 20 cows established with a broad genetic base may be of sufficient size to make improvement through selection in spite of the inbreeding depression.

2. Our work indicates that heifers eat as much feed per unit of body weight as bulls but gain less rapidly; consequently, heifers are considerably less efficient in feed use. Rapidly gaining bulls also consume no more feed per unit of body weight than slow gaining bulls.

VII. Work planned for the future:

1. Continue the Angus line as a two-sire and 20 cow population.

2. Continue the establishment of the two synthetic Hereford lines, one based on use of our 1 x 2, 1 x 3, and 2 x 3 bulls and cows and the other based on our 1 x 2, 1 x 3, and 2 x 3 cows mated to 1 x 4, 1 x 10, and 4 x 10 U. S. Range Livestock Experiment Station bulls.

3. Complete the evaluation of our inbred and linecross females when mated to one and the same Angus bull for two calf crops.

4. Analyze the data on the production records, blood chemical studies, and carcass and meat evaluations of calves produced in our

diallel matings involving our three Hereford lines. Prepare manuscripts for publication of this material.

5. Continue the study of elite compared with index selection in house flies and mice.

6. Make cytogenetic studies of abnormal cattle that occur over the state.

7. Prepare a manuscript covering the study on selecting mice under varying levels of X-irradiation.

VIII. Publications and manuscripts:

Landers, John H., Jr., John D. Wheat and Ralph Bogart. 1967. Some factors affecting feed efficiency in beef cattle. Oreg. Agr. Expt. Sta. B. 102.

IX. Project summary:

Oregon Agricultural Experiment Station

Cattle Inventory - June 1968					Total
Breed	Hereford	Hereford	Angus	A.xH	
Line	1	2	4		
Purebred or grade	Purebred	Purebred	Purebred	Crossbred	
Bulls (12 mo. or over)	6	2	2	0	10
Cows (2 yr. or over)	70	0	21	0	91
Heifers (yearling)	0	3	5	0	8
Calves - Bulls	14	3	9	21	47
- Heifers	4	5	12	15	36

Cow Production Data - 1967 calf crop

Number cows bred to calve:					
As 2-yr.-olds	0	0	6	18	24
At 3 yr. and up	9	12	17	18	56
Number calves born from:					
2-yr.-olds - Alive	0	0	6	15	21
- Dead	0	0	0	0	0
3-yr.-olds and up - Alive	6	8	13	15	42
- Dead	0	0	1	1	2
Number calves weaned	6	8	19	30	63
Percent calf crop ¹ - Born	67	67	83	83	79
- Weaned	67	67	83	83	79

Prewaning Performance - 1967 calf crop

Birth weight - Bulls	77	85	71	73
- Heifers	69	79	67	65
Weaning age - Bulls	180	172	171	182
- Heifers	162	145	163	169
Weaning weight - Bulls	382	422	433	389
- Heifers	342	355	375	347
Adjusted weaning weight ² - Bulls	426	485	506	429
- Heifers	416	467	455	407
Weaning score:				
Conformation - Bulls	11.0	12.2	12.4	--
- Heifers	11.1	11.9	12.4	--
Condition - Bulls	10.7	11.3	11.3	--
- Heifers	11.0	11.2	11.4	--
Average inbreeding - Males	6.41	0.00	10.88	0.00
- Heifers	0.72	0.00	11.30	0.00

¹Calves born alive or weaned/cows bred²205-day weight = $\frac{\text{weaning weight} - \text{birth weight}}{\text{age in days}} \times 205 + \text{birth weight}$

Oregon Agricultural Experiment Station

Postweaning Performance - 1967 calf crop

Breed	Hereford		Hereford		Angus	
Line	1	1	2	2	4	4
Sex	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
Method of feeding	Individual Feedlot					
Number on test	3	3	4	4	7	12
Average age on test	220	193	186	176	180	179
Initial weight	453	408	448	399	460	405
Initial score:						
Condition	10.7	11.0	11.3	11.2	11.3	11.4
Conformation	11.0	11.1	12.2	11.9	12.4	12.4
Days on test	112	163	109	143	112	154
Average daily gain	3.21	2.16	3.36	2.47	3.13	2.29
Feed efficiency:						
TDN/100 lb. gain	368	512	367	462	408	516
Final weight	811	758	813	753	808	754
Final score:						
Condition	11.6	11.9	12.4	12.5	12.2	12.4
Conformation	11.7	11.7	12.9	12.7	13.0	13.0
Average inbreeding	6.41	0.72	0.00	0.00	10.88	11.30

Line 1 = O.S.U. Line, Line 2 = Miles City

UTAH STATE UNIVERSITY

- I. Station: Utah Agricultural Experiment Station
- II. Project title: Development of selection criteria for improvement of efficiency in growth and fattening in cattle
- III. Personnel:

Experiment Station:

James A. Bennett, Project Leader, A. Junior Nyman, and William J. Nay, Jr.

U. S. Department of Agriculture, Agricultural Research Service, Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

- IV. and V. Nature and extent of work done this year and summary of progress:

The Utah project was revised during early summer in 1967 and work this year is following along according to the plans. Calves are now being born to cows in the project. These consist of Herefords and a limited number of Charolais. There will be some Shorthorns and Charolais x Shorthorn crosses. These calves will be used in efficiency of feed utilization studies, as outlined in the project.

The bull calves that were weaned last fall in the old project were put on the standard individual postweaning feeding test.

- VI. Application of findings:

No results have been obtained as yet under the revised project.

- VII. Work planned for the future:

Matings will be made to yield straightbred Herefords and Charolais, and crosses between the two. Feed requirements during the growth stages and during fattening will be determined. Estimates of composition of carcasses will be made on animals slaughtered at approximately 205 and 365 days as well as at 950 to 1000 pounds body weight or equivalent condition constant body weight.

- VIII. Publications:

None

IX. Project Summary:

Utah Agricultural Experiment Station

Cattle Inventory - June 1968

Breed	Hereford Panguitch	Hereford Logan	Shorthorn Logan	Charolais
Line	I	II		Reg- istered
Purebred or grade	Purebred	Purebred	Purebred	
Bulls (12 mo. or over)	21	2	1	
Cows (2 yr. and over)	52	13	19	4
Heifers (yearling)	9	5	5	5
Calves ¹ - Bulls	24 ¹	8	7 ¹	2 ¹
- Heifers	22 ¹	5	8 ¹	2 ¹

¹Calving not completed

Postweaning performance - 1967 calf crop

Breed	Hereford	Hereford	Shorthorn
Line	I	II	
Sex	Bulls	Bulls	Bulls
Method of feeding		Individual	
Number on test	25	3	5
Initial weight	536.6	495.0	569.8
Final weight	801.0	753.7	810.2
Days on test	90.0	90.0	78.4
Average daily gain	2.96	2.77	3.07

WASHINGTON STATE UNIVERSITY

- I. Station: Washington Agricultural Experiment Station
- II. Project title: Comparison of breeding systems for improvement of beef cattle
- III. Personnel:

Experiment Station:

C. C. O'Mary, Project Leader, Dan Coonrad

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado

Bradford W. Knapp, Acting Investigations Leader

- IV. Nature and extent of work done this year:

The project leader was on sabbatical until August 15, 1967. Until that time, routine data were collected to fulfill the objectives and provide information for the W-1 Project Summary on cow production data, preweaning, and postweaning performance.

The 1967 calves were weaned and the performance test started in September. All calves in Groups A, B, and C are being individually fed on all-pelleted ration. The new beef cattle testing laboratory provides facilities for testing 30 bulls in individual pens. Feed and water are available ad libitum. Facilities are provided for 35 heifers in individual stalls with five heifers per pen. Heifers are put into the stalls twice daily for feeding.

A system of manure removal was planned to allow for washing the manure into a pit, and removing to fields with a "honeywagon." Because of the amount of labor required in cleaning, the practice now is to use deep bedding.

Cooperative work with the Hawaii Station is being continued. Semen from three bulls was collected. Failure of the semen from one of the bulls to freeze properly resulted in only two bulls being used.

- V. Summary of progress and conclusions to date:

Comparisons of herd sires of the three groups have shown definite superiority of T.E. 6 and A-10 over Eileenmere 100. Consequently, Eileenmere 100 was replaced by a son of T.E. 6. Progress in groups A and B in the breeding program has been delayed in that Eileenmere 100 produced no superior son to replace T.E. 6. As a result, more inbreeding in the T.E. 6 group will be made than was originally planned. The conclusions reached are that when a bull has proved to be inferior on performance he should be replaced as quickly as this fact becomes known.

A tested bull with superior records may not be readily available from outside sources. Thus, a breeding program not only requires a good herd sire, but also a proven reserve sire in case of emergency.

VI. Application of findings:

In a performance testing program for purebreds, more herd sires should be kept than are actually used for breeding so the program will not suffer in the event that (1) a bull suddenly becomes a non-breeder, or (2) a satisfactory replacement sire cannot be found when needed. This is especially important in a high quality, high production herd.

VII. Work planned for the future:

Because of the need for a better method of comparison of animals on feed efficiency, calves will be weaned at a more nearly constant age than in the past. Calves will go on test and come off test at a constant age, and slaughter animals will be killed at a constant age.

Replacement heifers in all three groups will be bred as two-year-olds to one nonrelated bull for one calf crop before being placed in their respective groups. This will give a measure of comparison and of the progress within the three groups.

VIII. Publications:

None

IX. Project summary:

Washington Agricultural Experiment Station

Cattle Inventory - June 1968				Total
Breed	Angus			
Line	A	B	C	
Sire	TE6	436	A10	
Bulls (12 months or over)	11	14	16	41
Cows (2 years or over)	33	34	29	96
Heifers (yearlings)	12	6	11	29
Calves - Bulls	11	14	11	36
- Heifers	7	9	7	23

Cow Production Data - 1967 calf crop				Total or average
Number cows bred to calve:				
As 2-yr.-olds	7	6	6	19
At 3 yr. and up	27	24	23	74
Number calves born from:				
2-yr.-olds - Alive	6	6	5	17
- Dead	1	0	0	1
3-yr.-olds and up - Alive	22	21	22	65
- Dead	2	1	0	3
Number calves weaned	27	27	27	81
Percent calf crop ¹ - Born	91.1	93.3	93.1	92.4
- Weaned	79.4	90.0	93.1	87.0

¹Based on number of cows bred

Prewaning Performance - 1967 calf crop				Average
Birth weight - Bulls	72	71	71	71
- Heifers	62	68	66	65
Weaning age - Bulls	218	210	197	208
- Heifers	197	198	216	204
Weaning weight - Bulls	522	527	497	515
- Heifers	429	416	492	446
Adjusted weaning weight ² - Bulls	523	536	533	531
- Heifers	453	452	487	464
Weaning score - Bulls	13.2	13.1	12.9	13.1
- Heifers	13.4	13.0	14.0	13.5

²Adjusted for age of calf (205 days) and age of dam (15-10-0-5)

Washington Agricultural Experiment Station

Postweaning Performance - 1967 calf crop				Total
Breed	Angus			
Line	A	B	C	
Sire	TE6	436	A10	
Sex	Bulls			
Method of feeding	Individual			
Number on test	10	14	7	31
Average age on test	244	239	233	239
Initial weight	573	589	592	585
Days on test	151	151	151	151
Average daily gain	2.54	2.46	2.71	2.57
Feed efficiency:				
lb. feed/100 lb. gain	785	807	792	795
Final weight	956	962	1000	973
Final score:				
Conformation	13.1	13.4	13.6	13.4

Postweaning Performance - 1967 calf crop				Total
Breed	Angus			
Line	A	B	C	
Sire	TE6	436	A10	
Sex	Female			
Method of feeding	Individual			
Number on test	12	4	10	26
Average age on test	236	249	238	241
Initial weight	479	513	506	499
Days on test	151	151	151	151
Average daily gain	1.56	1.74	1.58	1.63
Feed efficiency:				
lb. feed/100 lb. gain	959	1001	951	970
Final weight	715	776	744	745
Final score:				
Conformation	13.8	14.0	13.9	13.9

UNIVERSITY OF WYOMING

- I. Station: Wyoming Agricultural Experiment Station, Laramie,
and Gillette Substation, Gillette
- II. Project title: Criteria for improving effectiveness of selection in beef cattle
- III. Personnel:

Experiment Station:
George E. Nelms, Project Leader, R. A. Field, and M. L. Riley, Animal Science Division; Leon Paules, Substation Division; Brinton Swift, Veterinary Science Division; W. W. Ellis, Biochemistry Division

U. S. Department of Agriculture, Agricultural Research Service,
Fort Collins, Colorado
Bradford W. Knapp, Acting Investigations Leader
- IV. and V. Nature and extent of work done this year and summary of progress:

The effects of inbreeding on carcass traits have been evaluated. Partial regression coefficients of some carcass traits on inbreeding and weight are:

	Inbreeding "b"	Slaughter weight "b"
Rib eye area, cm. ²	-2.418*	0.772
Fat depth, mm.	0.405*	0.013
Length of body, cm.	-.223	0.101
Grade	-.016	0.006
Marbling	-.006	0.005
Cutability, %	-.004	0.001
Depth of round, cm.	-.044	0.047
Kidney fat, mg.	-.001	0.002

Some recent data from Canada and Australia indicate that an approach to carcass improvement might be enhanced if the muscle to bone ratios were considered. Since the Wyoming project is concerned with carcass improvement, this is being investigated. Data were available on about 140 carcasses for the study. To date, prediction equations have been developed from measurements easily obtained without destruction of the carcass.

R^2

$$\begin{aligned} \text{Wt. of muscle in carcass} = & \\ & - 17.8 + .627 (\text{carcass wt., lbs.}) - 56.5 (\text{fat depth, in.}) \quad 94 \\ & + 12.5 (\text{wt. of muscle in forearm, lbs.}) \quad \text{S.E.} = 13.7 \end{aligned}$$

Wt. of bone in 1/2 carcass =
 $0.87 + .026 (\text{carcass wt.}) + .63 (\text{depth round, cm.}) + 2.0$ 88
 (wt. of forearm muscles) - 1.11 (% kidney fat) S.E. = 2.51

Wt. of fat in carcass =
 - $9.1 + .270 (\text{carcass wt.}) + 58.27 (\text{fat depth})$
 - $15.8 (\text{wt. of forearm muscles}) + 4.40 (\% \text{ kidney fat})$ 78
 S.E. = 13.9

These data apply to bull carcasses only, on carcass weights ranging from 450 to 800 pounds. It appears that muscle weight and bone weight can be predicted fairly accurately. Muscle:bone ratio could not be predicted directly.

Routine data as called for by project outline are being accumulated. Cooperation on the regional genetic-environmental project is being continued.

VI. Until comparisons between inbred sires and outbred sires are made, the significance of the inbreeding depression cannot be determined.

It would appear that muscle weight and bone weight can be predicted so that muscle:bone ratios can be computed.

VII. Work planned for the future:

As outlined in project.

VIII. Publications:

Riley, M. L. and G. E. Nelms. 1968. Effects of inbreeding on carcass traits of bulls. J. Anim. Sci. (In press)

IX. Project Summary:

Wyoming Agricultural Experiment Station

Cattle Inventory - June 1968					Total
Breed	Hereford	Hereford	Hereford	Angus	
Line	Gillette	Laramie	Laramie		
	Growth		Carcass		
Purebred or grade	Purebred	Purebred	Purebred	Purebred	
Bulls (12 mo. or over)	4	2	11	5	22
Cows (2 yr. or over)	32	34	27	34	127
Heifers (yearling)	8	10	11	11	40
Calves - Bulls	16	19	8	13	56
- Heifers	16	15	9	15	55

Cow Production Data - 1967 calf crop					
Number cows bred to calve:					
As 2-yr.-olds	9	16	19	9	53
At 3 yr. and up	32	27	21	32	112
Number calves born from:					
2-yr.-olds - Alive	5	12	12	7	36
- Dead	1	3	2	0	6
3-yr.-olds and up - Alive	25	26	16	29	96
- Dead	0	0	2	2	4
Number calves weaned	27	37	28	33	125
Percent calf crop ¹ - Born	73	88	70	88	80
- Weaned	66	86	70	80	76

¹Number calves born alive or weaned/cows exposed

Preweaning Performance - 1967 calf crop				
Birth weight - Bulls	78	81	77	64
- Heifers	72	72	74	61
Weaning age - Bulls	185	203	198	200
- Heifers	188	205	210	204
Weaning weight - Bulls	388	442	412	420
- Heifers	360	395	399	395
Adjusted weaning weight ² - Bulls	348	356	353	354
- Heifers	348	356	353	354
Average inbreeding - Males	17	0	12	18
- Heifers	17	0	12	18

²Adjusted to 180 days

Wyoming Agricultural Experiment Station

Postweaning Performance - 1967 calf crop

Breed	Hereford	Hereford	Hereford	Hereford
Line	Gillette	Gillette	Laramie	Laramie
			Growth	Growth
Sex	Male	Female	Male	Female
Method of feeding	Group	Group	Group	Group
Number on test	14	11	18	12
Average age on test	195	198	203	205
Initial weight	393	367	442	395
Days on test	168	168	168	168
Average daily gain	2.38	1.42	2.60	1.56
Final weight	793	606	881	658
Average inbreeding	17.0	17.0	0	0

Postweaning Performance - 1967 calf crop

Breed	Hereford	Hereford	Angus	Angus
Line	Laramie	Laramie	Laramie	Laramie
	Carcass	Carcass		
Sex	Male	Female	Male	Female
Method of feeding	Group	Group	Group	Group
Number on test	11	11	9	13
Average age on test	198	210	200	204
Initial weight	412	400	420	395
Days on test	168	168	168	168
Average daily gain	2.75	1.60	2.41	1.48
Final weight	875	671	825	645

P R O J E C T R E P O R T S

PROJECT REPORTS

Arizona:

Dr. Roubicek:

One particular aspect of our work is of concern and that is how can we best evaluate the heifers from the line test program and what can we find in terms of this top cross.

Dr. Ray:

We did study Lines 1, 6, and 9 from Miles City and compared them with the industry (San Carlos) herd. We used the top cross bulls from the lines and top cross heifers in a systematic breeding design (table 1 of station report) to evaluate effects. All possible combinations were made. What we got are lines and an F_1 animal. There were sixteen breeding groups, and a total of 400 calves over a four-year period. Some cells were small. On this type of study you start losing cows after a couple of years because of spoiled udders, cancer eye, etc.

San Carlos sires had been within the herd for at least two generations. There may have been some slight advantage in bulls from San Carlos merely because there were more animals to choose from. Every effort was made to eliminate this. Everything was done to avoid bias. The biggest bias came from attrition.

Actually, I would say that we were comparing with an industry-type herd that is considerably above the average industry herd. But the results were definite enough that we should determine how we are going to proceed on a top cross test (tables 2 and 3 of station report).

Dr. Roubicek:

We have prepared a summary of the performance of bulls on test. Cows were allotted to sires within age group. Within an age group we used only cows that had calved the year before, then these were randomly allotted within sire groups--cows four to eight years old. The initial weight of the calves on test was ten days after weaning.

SIRE PROGENY

098 Bozeman 220

Tattoo	Date of birth	Initial weight	Final weight	Average daily gain	Score
7211	069	448	890	3.16	12/11
791	053	386	844	3.27	11/11
721	047	450	946	3.54	12/11
7203	068	484	956	3.37	13/12
7200	067	498	874	2.69	11/11
747	049	511	830	2.27	10/10
7169	065	498	1004	3.68	13/11

099 New Mexico 413

Tattoo	Date of birth	Initial weight	Final weight	Average daily gain	Score
7168	065	489	890	2.86	10/11
7304	086	412	Dead		
7266	076	438	864	3.04	11/11
7323	090	472	856	2.74	10/12
7297	084	364	774	2.94	12/12
7244	072	418	726	2.20	10/10

100 Wyoming 152

7145	060	429	860	3.08	11/12
759	051	500	984	3.46	11/12
714	044	466	892	3.04	12/11
788	053	409	820	2.94	10/10
7152	060	422	920	3.56	12/11
7282	082	452	950	3.56	11/11
7161	062	492	956	3.31	11/11
7159	062	411	808	2.84	11/11

101 M. C. L 14

7209	068	403	836	3.09	11/12
7408	127		Dead		
7348	101	317	Dead		

102 Brae Arden 1124

7242	071	463	888	3.04	11/12
7171	065	454	908	3.24	11/12
7301	085	364	710	2.47	10/10
7183	066	390	768	2.70	11/9

103 Nevada 684

7367	109	357	748	2.79	10/11
745	048	465	844	2.71	11/11
7219	069	452	850	2.84	11/11
79	044	480	840	2.57	10/10
7364	107	452	800	2.49	10/11
7103	054	381	856	3.39	11/12
777	052	517	932	2.96	12/12
7320	090	401	860	3.28	11/11
7192	067	403	806	2.88	11/11

104 Nevada K 333.

Date of birth	Initial weight	Final weight	Average daily gain	Score
064	404	770	2.61	11/10
067	440	844	2.89	10/12
048	504	1000	3.54	11/12
056	419	800	2.72	10/10
104	392	806	2.96	10/12
074	399	642	1.74	10/8
047	404	780	2.56	10/12
135	308	700	2.80	10/8

105 Utah 0133

131	349	754	2.89	10/11
064	358	710	2.44	10/10
089	370	784	2.96	10/11
048	504	1010	3.61	12/11
053	441	910	3.35	12/11
071	480	870	2.79	11/12
097	420	840	3.00	12/12

106 Royal 3164

066	431	828	2.84	11/11
058	363	790	3.05	10/11
070	423	894	3.36	11/12
049	469	980	3.65	12/12
065	489	886	2.84	12/12

107 M. C. L 4

082	406	864	3.27	12/10
048	371	784	2.95	10/12
115	347	710	2.59	10/11
044	460	950	3.50	13/12
090	370	776	2.90	11/10

A. I.

086	423	762	2.42	10/11
107	386	794	2.91	11/11
101	416	842	3.04	12/11
083	484	884	2.86	11/12
075	376	780	2.89	11/12
088	434	888	3.24	12/12
102	418	824	2.90	10/11
083	490	986	3.54	13/12

Conformation/condition. 10 is low choice, 15 is top score.

ARF Bonanza 5038 (Colorado State University

H Premier Domino 7 (Crowe Hereford Ranch

unknown

SIRE SUMMARY

Sire	Number	Initial weight	Final weight	Average daily gain
098	7	468	906	3.13
099	6(5)	436	822	2.76
100	8	448	899	3.22
101	3(1)	403	836	3.09
102	4	418	819	2.86
103	9	434	837	2.88
104	8	409	793	2.74
105	7	419	840	3.01
106	5	435	876	3.15
107	5	391	817	3.04
AI	8	428	845	2.98

California:

Dr. Rollins:

We are through with the crossbreeding project on the Davis campus. The matings called for at the Sierra Foothills range are going on as per schedule. We brought the calf crop in from the range, fed them out, and got extensive carcass data. Slaughtering have been completed but the data are not yet summarized.

Double muscling project: We slaughtered about 60 animals early this year. These included steers and heifers from the crossbreeding project (1216). They are being used as controls in the double muscling to identify heterozygotes and also to develop the meat index.

We are shaving the rear ends of animals to take a good look at the creases. We have added another item to the index--the gluteus medius. We are looking for more things related to muscle size. We will have that much more to identify the musculature in these calves.

I got data on about 40 bull, steer, and heifer calves--not complete data, yet it is useful. Among these animals were 26 offspring of what we consider a heterozygous Charolais bull.

I have a working hypothesis that double muscling is due to a single gene. We will work on that until we are proved wrong. From having reviewed the literature, I have adopted a second hypothesis, that dominance may vary breed to breed--dominant in the Charolais, and in the British breeds (Angus) it tentatively is thought recessive. This is an extremely interesting hypothesis to test. If the condition is caused by a major gene, then where it will be most advantageous to the livestock man would depend on carcass traits between heterozygous and homozygous animals. So far as the homozygous double muscled animal is concerned, it probably would not be

worthwhile to incorporate it in a herd, but get a good bull for use in an AI herd.

As to the difference between heterozygous and normal, in the calf crop just slaughtered we had the 26 offspring from a heterozygous bull. Making a very superficial approach, it looks as though we may be able to separate heterozygous from normal. We will do this not only for the carcass traits but also for our meat index and identification phenotype. In this test, the Charolais bull was mated to cows from the old crossbreeding operation (Angus, Hereford, and Short-horn). Therefore, the gene here is being tested in a background of half Charolais, half British breeds. Perhaps the hypothesis will show up more here than in the coming calf crop.

In this coming calf crop we used two heterozygous Angus bulls (red and black). We will see if we can spot the heterozygosity as easily here as with the Charolais bull. Probably the heterozygote animal is not going to be affected enough in the British breeds to detect it visually.

About future plans, in addition to mating those two heterozygous bulls in the last go-around, we also mated a homozygous Angus bull. We want to get a control population and also get the gene distributed.

The thing we are giving more and more thought to is the use of the homozygous double muscled animal compared with heterozygous and normal in response to nutrition, age, etc. I do know how sensitive a double muscled animal is to nutrition. About yearling age (six months to two years of age) take these animals and put them on a grain concentrate ration and in two months the rear end blows up like a balloon. Take them off and it comes down. It is not fat; it is muscle. Double muscle shows up more in bulls than it does in steers, more in steers than it does in heifers.

On a purely genetic basis, how much difference is there in the ability of an animal to lay down muscle?

Is double muscling connected with fertility? There is evidence that the double muscled animal is less fertile in Charolais. Among the Angus I have had pretty good luck with fertility. The Angus seems to be O.K. from the standpoint of frozen semen.

Does the double muscle show up at birth or later? My experience is that it does not show up at birth. One calf born was blocky. At two months of age it was turning into a double muscled animal.

The double muscled calves don't like to fatten up. They are carrying much too much weight for their bones. They are easier to spot on good nutrition, but they are not fat.

We haven't taken any biopsies of muscles yet, but we are planning to do that. One man is studying DNA, and one anatomist is

doing histological studies of fiber count and hopes to do studies on protein development.

Dr. Christian:

Why do you say it is a good gene to put into a breed if it affects fertility?

Dr. Rollins:

You would know all of your heterozygous animals. If you wanted to save your heterozygous females you identify them and mate them back to a normal bull. You would always know the gene was there and not mate it to a heterozygous animal.

About recessive or dominant--my hypothesis is that in the British breeds the mutant gene tends toward recessive, and in the Charolais the double muscle gene tends toward dominance.

Colorado:

Dr. Brinks:

We didn't have much to report on last year. This year we are in the middle of completing six theses in the spring quarter, so there is still much work to be done.

Much of the work dealt with changing records over into a new format, making some additions, and getting all of the records on punched cards. We are computing inbreeding coefficients by the computer using the Montana program which Knapp adapted for us.

Another addition is putting the calculated Most Probably Producing Ability value in our index and using this as a basis for cow culling. We have put this in our general Field Day report this year for all dams of bulls to be sold, and are trying to stimulate interest in this particular value in the state.

Most Probably Producing Ability (MPPA) as we use it is the ratio of the cow's producing ability to the herd's average. Each one percent above 100 is equal to about 7 pounds expected increase in weaning weight.

Studies about to be completed:

One is a carcass study developing equations for bulls and heifers for carcass cutability. The measures of cutability we used were closely trimmed retail cuts and total freezer meat from a side. We looked at this in two different ways--pounds and percent--and also these pounds and percents weighted by their actual dollar values. The results are shown in tables 1 and 2 of the report.

It appears that good progress in carcass traits can be made through direct selection, and also through indirect selection for rate of gain.

Another study deals with the effect of date of first calving on lifetime production, including both number of calves and total weaning weights. The earliest group of calves born was more than 15 days earlier than expected. Heifers that calve earlier the first time are going to produce more and heavier calves. We think that early calving is more toward the optimum time under our conditions. The calves get a good start before they hit grass. Group 1 is the first 20 days plus an additional 15 days prior to that. A 90-day breeding season is customary, 115 days the normal calving season. Fifteen days prior to accepted date is "early," five days after is "late." Most of the calves are born in the 115-day period.

It appears that we should breed first-calf heifers so they will calve early the first time.

Hawaii:

Dr. Cobb:

I would like to report on the general outlook of the cooperative work with Arizona. We have been carrying through getting weaning and postweaning data. We have been getting about 30 head, plus or minus, bred to each bull from which we have semen. Unfortunately, due to the very low percentage of conceptions, about 30 percent, we have not been getting the number of animals per sire we would like to have and which is called for in our original plans.

We have one rancher who is interested in continuing some inseminating work and would be willing to use his animals as test animals if any one of you is interested in working through us. We are working with Washington State and are getting some data we provide back to Washington State on their bulls.

The most discouraging thing about the program has been the low conception rate. We have had enough animals that although we have difficulty detecting animals in heat there is no problem with numbers. It is the low conception rate.

We had very poor results with the Royal line, and I take it there has been some problem with that line in the past. Another thing we have noted, animals that are bred with a short interval between calving and breeding we get very poor results. A very short interval is up to 40 days. We get practically no conceptions. Forty to 60 days--no calves. Nine calves at 60 to 90 days. This agrees with dairy cattle. The ranchers have records on these cattle. They shouldn't inseminate them.

We think maybe our timing is not as good as it should be between the time an animal is detected in heat and time of insemination. Some of this we don't have complete control over.

The crossbreeding work is continuing as scheduled and will be carried on over a period of years and we will get some more information than we planned. We are planning to use sires at one location in one year and at another location in another year. We have taken over a prison herd and hope to get some crossbreeding information from those animals.

We will work next year on analysis of the five-year study and emphasize crossbreeding work, with less emphasis on other work. We will get feedlot and carcass data on crossbreds. We hope to get records next year on calves born from this year's inseminations, although we don't expect to get any more semen.

Dr. Brinks:

This genetic-environmental interaction is extremely interesting to me. You have the results. Where do we go from there? Will you follow up on basic reasons as to what is causing it?

Dr. Cobb:

I don't have any specific plans. I am a little at a loss as to how to get at the basic cause. We have limited data, but it seems to be very real. Dr. Warwick got some indication in the work on identical twins--reversal of lines of sires between two regimes.

I think we were on the right track in setting up this study, but we didn't have adequate numbers and adequate time.

Idaho:

Dr. Christian:

We have initiated methods of measuring physiological maturity. We have 18 calves in a preliminary study. Starting this fall, we have a cooperator using six of our University bulls in his herd. We will bring in the calves to be fed at the University from weaning to 1000 to 1050 pounds and slaughtered to determine the changes in physiological maturity. We will use bone development changes, bone structure including breakage, some work in connective tissue, some histological work on muscle fibers, and muscle biopsies up to the time when the animal is slaughtered. Leon Orme is planning to use biceps femoris because there is no connective tissue, trying to show any changes he can find in muscle tissue from weaning up to slaughter, which will be at varying ages. Part of the determination on ages will depend on what he finds in the cattle slaughtered this year. This will be started this fall. I am interested in whether we find sire differences in, say, bone and fat, what changes we can find in muscle structure. We

have not included the Angus and Shorthorn breeds in this yet. Whether we do will depend on what he finds in the other cattle he will be working with.

We will get slaughter information on the first calf crop from six bulls leased to the other cooperator who feeds out his own calves--two Angus, two Hereford, two Shorthorn bulls. It will demonstrate, perhaps, only the real advantages or disadvantages of these three breeds on this commercial herd.

Last year I presented some information concerning a description of fertility and the fact that fertility follows a geometric distribution. In the meantime, we have taken information from eight other studies reported in the literature and we find fairly close approximation from the standpoint of fertility. It means one thing, I think--that fertility follows a probability distribution. In all studies which concern fertility we are essentially conducting a progeny test for fertility. Because of this, the problem has come up, what effect do we have on the progeny test if we vary the number of observations. There also is in my mind the fact that fertility is a quantitative trait that can be expressed only qualitatively. And, also, we vary the number of observations depending on the phenotype.

We are going to set up a synthetic population by computer and attempt to get at this problem, allowing the number of observations to vary.

Montana:

Dr. Blackwell:

We are trying to finish analyzing the old data that have been collected.

Genetics of milk production: We took milk samples from line-cross and straightline cows from Miles City Lines 1, 4, 6, 9, and 10, and from cows in the crossbreeding study. In the Bozeman laboratory the milk samples were categorized for the different types of milk proteins. What we want to do is get some idea about the inheritance of this, then attempt to relate the incidence of this to some of the production factors. This year we will have a larger number of samples, some from the same cows, some from different cows. There are differences there. How much they will mean to industry we can not say.

Professor Flower became interested in a project regarding inbreeding rotated with outbreeding within a population of Japanese quail. He has a selected noninbred control and an unselected control. In one mating system he is producing 25 percent inbreeding every time he inbreeds, then goes to zero--alternate generations of inbreeding and outbreeding. In the other program, matings are at random. Thus, mass selection with random matings will be compared with the alternating

system of breeding. What will selection do for you in one system in comparison with selection in another system? Or, what will two alternate methods do for you in contrast to just normal selection?

Most inbreeding work has been gradual over a period of time. Perhaps this alternate inbreeding and outbreeding will expose something we have not seen before in an animal population.

U. S. Range Livestock Experiment Station:

Mr. Urick:

One project deals with breed crossing for increased production. Phase 1 is completed and a manuscript prepared on preweaning and weaning. We got 4.5 percent hybrid vigor in steer calves and nothing in heifers. Feedlot gain indicates we are getting 2.5 percent hybrid vigor in the steer crossbreds.

Phase 2 evaluates maternal qualities of the crossbred dams. We have obtained all of the data and summarized the three years of data. We have found that we got a slight advantage from crossbred dams of 3.5 percent for steers but nothing for heifers.

We have these divided into two groups of dams--one group having Hereford, Angus, and Charolais breeding and the other having in addition Brown Swiss. We got a lot more advantage from the Brown Swiss dams. It does appear the Brown Swiss are contributing quite a little to milk production over the beef breeds.

From Phase 3 we have two calf crops comparing straightbreds with two- and three-way rotation and a synthetic variety crossbred bull on crossbred dams. And the Brown Swiss study separately. There has been some advantage from the two-way rotation over the straightbreds and a slight advantage in the three-way over the two-way, but there are several differences.

With the Brown Swiss crossbreds initially we had some low conception rates. We were getting 20 percent lower conception and we thought it might be a breed characteristic. But the original cattle may have had some problems. In later years we found that the Brown Swiss dams are producing a little better than the others.

In Phase 3, the Brown Swiss dams excelled the three-way rotation of beef breeds.

While we were consistently hitting on slaughter grades we were consistently grading them about half a grade down on foot and they were grading better in the carcass. The Brown Swiss have a little better carcass grade--better marbling, better rib eye. The Brown Swiss would seem to contribute to carcass quality along with feedlot gain.

The synthetic variety has not produced enough to give us any particular trends. So far we have only one year of data.

In the carcass line, we have given Colorado State University some carcass data to analyze.

Development of superior lines: This work is continuing with Lines 9, 12, and 14. We have had some differences so far in breeding ability of bulls of some inbred lines. It showed up in the Genetic-Environmental Interaction program. The semen was good but the bulls were not working. Semen testing seems not to be the best method of testing the bulls. Last spring we resorted to another method of testing sires by actually exposing them to a heifer that came in heat, and we found if a bull is not working you might as well not use him.

Phase 2 of the crosslines: There is one more year of calves to be produced. Bulls obtained slightly more advantage from crossline dams than heifers.

Phase 3: We have only one year of data. We have a very limited number of animals. The three-way rotation looked good.

Genetic Environmental Interaction: This study is continuing. It appears we are getting a little narrowing of spread between Brooksville cattle and Miles City cattle. Either Brooksville cattle are adapting or there has been some selection. We have not had the results from Brooksville except that they are complaining some about fertility. Up to now, the Brooksville cattle have out-performed Line 1 most noticeably in weaning weights, while at Miles City it is the reverse--the Miles City cattle out-perform theirs.

Nevada:

Dr. Bailey:

We have continued with the three lines as they were set up originally--five two-sire lines, three at Reno and two at Knoll Creek.

Calves on test now will come off about April 15. To date, within locations, there does not seem to be much difference in the traits for which we are practicing selection. That more or less is the story for the regular selection criteria.

For the past three years we have fattened out some of the bulls from each of the lines. Bulls are brought to Reno. They all receive the same ration, and are on test 140 days postweaning. At the end of the 140 days we pick out two bulls from each line for breeding. Half of the others are slaughtered to determine carcass quality. The remaining bulls are fed out to 1000 pounds. The least-squares means are given in table 1 of the report. These data were analyzed separately by locations for each of the two groups and line comparisons within

locations made. The carcass fat percentage is using specific gravity technique and the California formula. There are approximately 150 animals involved in this three-year fattening test, so for any one group the numbers are small. It is surprising, however, to get no differences during the regular performance test, but during the subsequent period we do.

One other aspect in the post-performance test fattening period was to develop measures of efficiency.

The other part of the work is the rat study, which has been terminated. We are going to analyze all of the data collected over the past number of years. We had replicate select lines on a regular diet along with the control, and also a restricted diet for replicate lines and control. This was carried on for six generations. The sires from the four select lines were mated to unrelated control dams on the two diets. So we had comparisons on the two diets. It looks as though sires developed on regular diet sired progeny that gained a little more rapidly on both diets.

New Mexico:

Dr. Holland:

Regarding the heart defect studies, I have not been able to produce these defects with the matings I have made. For the patent ductus arteriosus defect we used a sire that had produced calves with the defect, then made 13 sire-daughter matings. We slaughtered the steer calves and some of the bull calves and some of the heifer calves. Some that we haven't slaughtered have growth rates, etc., that give no indication they have a heart problem. We routinely autopsied everything that died and checked the hearts of all animals that were removed from the herd at all ages. There have been enough matings to conclude that it is not simply inherited, if it is inherited.

For the septal defect we used a sire that had sired the defect, mating him to daughters of a bull that had sired the defect. I am at a complete loss as to why we did not pick it up. Between 1958 and 1964 we picked up eight calves that had the defect. This made us think we should check the herd for this defect.

The literature says the ductus arteriosus closes shortly after birth, but nowhere can I find what they mean by "shortly." In a newborn calf I have found it open, and open at three weeks of age in a calf that died of scours.

A graduate student looked at birth percentages and percent of calves at weaning from 1935 to 1964. The project came under W-1 in 1948, but we had this type of information available from 1935--999 matings in the herd. We used the Chi square analysis. When one uses this method the number of variables considered at a time must

be restricted. So we do plan to analyze these by least squares to see if the results are the same.

We analyzed data from steers slaughtered in three years.

We will publish on the ventricular and ductus arteriosus defects next year.

In the revision of the project we are toying with the idea of moving the Old Line out to the College Ranch and dividing it into two groups--one group with straight Old Line (high inbreeding), and crossing the other part of the Old Line with sires from a line somewhere else in the Western Region. We want to keep the Old Line until it is evaluated.

Oregon:

Dr. Bogart:

We had three lines of Herefords and made diallel crosses among these lines and have made all combinations. We have gathered all information on all of the calves born from these diallel matings--gains up to weaning, gain during feed test on heifers 400 to 750 pounds and on bulls 450 to 800 and 800 to 1000 pounds. We slaughtered all bulls except six which we kept for breeding. Carcass information included rib cut, so we did organoleptic tests on this.

We are starting two lines with the linecross animals--one with our 1 x 2, 1 x 3, 2 x 3, and one bred with Miles City bulls. We are getting the second crop of calves from these. This will be a synthetic line with six lines going into it. We will have three lines going into one, and the synthetic line with six lines represented.

We have continued the Angus line as a 20-cow two-sire closed herd. I am amazed at the productivity increase in our Angus line. We have two cows that have proved to be outstanding in the kind of calves they have produced, so we are thinking about trying to see what might be done from the standpoint of a gene improvement if we were to transfer eggs from these cows bred to outstanding bulls and increase the numbers of that kind of animal drastically and at the same time keep the line with normal matings.

(Dr. Christian commented that the chances of getting more than one or two calves per cow were pretty slim.)

We have had to test out all of the linecross cows. The way we are testing their calf-producing ability is that each is mated to one and the same Angus bull to get two calf crops, and we have the last two of these heifers to be mated this next breeding season to get that test done.

We have completed a study on mice in which we have selected

lowly and highly irradiated mice. The mice that were under 50 and 100r irradiation went out at about the fourth and fifth generation on fertility. The frequency of mammary cancer went up to about 14 percent in those two groups. I don't know why either thing happened. We did irradiate, then breed. We got a fairly high settling, breeding immediately after irradiation. But when we took mice that had been irradiated and gone two or three months after irradiation they were all sterile. Their ovaries were not functional.

We will continue our elite selection as against the index selection. We are in the fifth generation of mating mice, and I don't know just how it is going to work out.

We are making a chromosome study of abnormalities that we can pick up and are looking for deletion of a chromosome or addition of a chromosome or a translocation.

Dr. Bennett:

Where are you getting your abnormal calves, and what types?

Dr. Bogart:

I put out a notice to all County Agents and asked for their cooperation. Someone put the letter in the Farm Journal. I am getting more response from the Farm Journal. The types--intersex, crooked, bulging heads, dwarfs--midgets that weigh 50 pounds, and walk around and eat.

Our procedure for next year is to continue with the cattle as we have and we want to complete the evaluation of these females, inbreds and linecross, and analyze the data on all diallel matings and get out publications. We will complete our studies on the elite and index selection in mice and house flies. We are running into a lot more trouble with the house flies than with mice.

Utah:

Dr. Bennett:

The Utah station has very little to report in the way of research at this time. The project revision was reviewed at the last meeting.

In the new project we established Charolais as one group and compare these with Herefords and crosses for efficiency. We made some Shorthorn x Charolais crosses, but no Charolais x Hereford. We did cross a Charolais bull on some Shorthorns.

Last year we had two Charolais steers on test with Herefords and Shorthorns. This year we have two, also. The Charolais have not done

well. Of eight steers last year, the two bottom ones were Charolais. The ones we have this year, the Charolais will be the bottom again. We have more variation in the Charolais breed than in the other breeds. We have some better cows coming in and hope to build up numbers as soon as we can dispose of the Shorthorns. The straight Shorthorn calves are going on individual feeding test.

We are going ahead with the crossline tests with Brae Arden and Havre Line 2.

We hope to measure efficiency in these two different genetic groups next year and tie it down somewhat as to differences in age. I hope to get some information on body composition and relate this back to feed use.

Dr. Bogart:

How do you define energy?

Dr. Bennett:

Efficiency--gain in body weight in relation to feed intake--TDN. As we go along we think we will define it as something different from that. We hope we can get metabolized energy.

Wyoming:

Dr. Nelms:

We tested the effects of inbreeding on some carcass traits. Only two showed any significance--fat depth and rib-eye area.

Australia and Canada have reported work on muscle to bone ratios. We had data available on 140 carcasses we could look at. We could not predict muscle:bone ratio as accurately as they reported. We could predict weight of bone and weight of muscle better than weight of fat.

PROJECT REVISIONS

PROJECT REVISIONS

Arizona:

Dr. Roubicek:

The project is due for revision a year from June. I don't have a written proposal. In order to write the project in a way that will meet with the approval and understanding of all concerned we need to know, what do we do with these heifers from the line test program? The point is, we are in a situation where we are not going to have these sires coming in from these lines, so we are not going to be able to set up a breeding plan which uses the line sires per se.

Dr. Brinks:

If the stations furnished the sires for a year would the Indians provide transportation?

Dr. Roubicek:

I don't know. It would involve a lot of work. If there is another satisfactory way it might be better to do it.

We feel that the reproductive performance and the weaning performance of these topcross heifers is extremely important in evaluating these lines. We want to do the best we can. But at the moment we don't know what is the best procedure to use in setting up our mating system.

Dr. Brinks:

Without sires from the stations, what would be wrong with a design almost exactly like you had before? You still have industry comparison.

Dr. Roubicek:

Then you make a decision on what is your program, because you can not set up the whole ten sires. You could use Miles Citytop cross bulls on heifers from other lines. You can do this sort of thing, but you have to make decisions on what to use. What kind of bulls are we to breed these heifers to to get the information you want?

Dr. Bogart:

The first question to raise is, what are your objectives? To compare all of these lines of sires which have been used at San Carlos? If that is the objective, the thing to be done is get some

bulls unrelated to the females and randomize them so you can evaluate the lines from Miles Qty against the lines from Wyoming, against Nevada, etc.

How many cows are involved?

Dr. Ray:

One hundred fifty to 200 per year for four years--about 600 to 800 total. Ten lines, 50 cows per line, replicated--40 bulls. These are registered cattle. You have to keep them separate. We have 18 breeding pastures.

We actually are just getting into this cow performance data. We are evaluating cows and their calves during the early summer. This evaluation includes a number of factors. We try to rank them on skeletal size, udder evaluation, abnormalities, calf is weighed and scored. This is too new to know whether we are getting all of the information of the kind we need, but it is an attempt to get more critical information on the cow side.

Dr. Brinks:

Does the group feel they want to continue the inbred line testing, and if so would you test the same ten lines or would you use some other lines from the region?

Dr. Roubicek:

Before I could answer that I would have to have a conference with the people at San Carlos.

Dr. Brinks:

So far as Colorado is concerned, we would like to see it done. We would like to see the possibility of other lines being tested.

Dr. Roubicek:

We will have to come up with a plan. Will you send me your suggestions. I will look them over and then will draw up a plan and circulate it to you.

Colorado:

Project Revision

- I. Title: Comparison of mating systems and mass selection in beef cattle production
- II. Objectives:
- Compare mating systems for maximizing heterosis by comparing 1) linecrossing within breeds, 2) crossbreeding using outbred parent stocks, and 3) crossbreeding using inbred parent stocks
 - Compare these three crossing schemes with mass selection as methods of improving beef production
 - Determine the effects of intensive inbreeding on various traits
 - Determine the response to selection within lines and in rotational crossing schemes
 - Provide inbred and linecross genetic material for biochemical and physiological studies
- III. Procedure:

A. Source of Cattle

Eight of the nine existing inbred Hereford lines (120 head) will be maintained along with 100 head of existing linecross cows to continue the previous work. Excess linecross cows will be sold to provide facilities and finances to purchase 80 head of registered Angus females.

B. Plan of Investigations

Work with the eight existing inbred lines and linecrosses among them will be continued as described in the previous project outline. The experimental design for the additional work is presented below:

Breed and line of dam*	Breed and Line of Sire*						
	Inbred				:	Outbred	
	H ₁	H ₂	A ₁	A ₂	:	H ₀	A ₀ : Total
H ₁	10	10	2	3	:		: 25
H ₂	10	10	3	2	:		: 25
A ₁	2	3	10	10	:		: 25
A ₂	3	2	10	10	:		: 25
	-----				:		:-----
H ₀					:	20	10 : 30
A ₀					:	10	20 : 30
Total	25	25	25	25	:	30	30 : 160

*H₁ and H₂ represent two new inbred Hereford lines to be developed from existing linecross cattle, A₁ and A₂ represent two new inbred Angus lines, H₀ and A₀ represent outbred Hereford and Angus, respectively.

C. Types and Numbers of Matings

Hereford	
Inbred	20
Linecross	20
Outbred	20
Angus	
Inbred	20
Linecross	20
Outbred	20
Crossbred	
Inbred parents	20
Outbred parents	20

The same traits would be used in selection of sires and females for all inbred and outbred groups. The same culling procedures would be used on all females. Systematic repeat matings, 25 per year, will be used as an environmental control on years. Present management procedures will be used.

IV. Probable duration: 10 years

V. Personnel: J. S. Brinks, Project Leader, Kent Riddle, Russell Sutton, and Glenn Richardson

Dr. Brinks:

What we want to do is extend the type of information we have been obtaining at Colorado for the past 20 years--information on inbreeding but also information on hybrid vigor. We would like to extend it by getting information on linecrossing vs. crossbreeding. The two big questions we will ask:

How does linecrossing within Hereford and Angus lines compare with crossbreeding? One of the things we would like to do is compare mating systems for maximizing heterosis.

The second question:

How do these mating systems compare with mass selection within a large closed herd?

Biochemical and physiological studies also will be expanded.

We can reduce the number of our linecross dams without losing any information. We plan to reduce the linecross dams by possibly 50 head to make room for purchasing Angus cattle. This design calls for purchsaing 80 head of Angus to form two lines and forming two new Hereford lines from present cattle.

Dr. Rollins:

The crossbreeding work is of double interest. It has some genetic interest and it is of practical interest. If you get heterosis, you already have the animals to go ahead with. With inbreeding, how useful will the results of a mating be? Then, how much material is available for use if it proves useful?

Dr. Brinks:

Do you mean will there be enough of the inbreds actually to make material available to industry if it proves successful from experimental work?

Dr. Rollins:

What if one envisions topcross testing of bulls in comparison with crossbreeding? Then if you get a bull that works out you can freeze semen that could be available to industry and you also get a genetic evaluation.

Dr. Brinks:

We are getting some topcross information from industry.

Dr. Cobb:

I don't think that everything we do has to be something that will go out and be immediately available to industry. We have to have facts, too.

Dr. Bogart:

Is there any possibility that you can tie in with ranchers who might be interested and expand numbers and get field information as well as station information?

Dr. Brinks:

I think there is a possibility and we plan on doing some of this. Also, the AI studs should provide some information needed on specific crosses between lines used.

Dr. Christian:

Are there any comments on the Colorado project? Do I hear a motion for approval?

Dr. Bogart:

I move the Colorado project be approved.

Dr. Bailey seconded the motion. Motion carried.

Montana:

Dr. Blackwell:

We have a project that has been approved as a station project by the Montana Station which is a possible contributing project to W-1, but not the overall project. It is a study of breeding systems with laboratory animals. Whether it has a direct bearing on cattle breeding I don't want to speculate, but if it is of interest to the group here they may want to consider it as contributing to the overall project from Montana.

Dr. Brinks:

I think if we are kept informed each year it will be sufficient.

Dr. Blackwell:

We will keep you informed of progress on the project, but it will not be considered a part of the W-1 project.

Utah:

Dr. Christian:

The Utah project was discussed last year. It is in order that we complete approval on this project.

Dr. Cobb:

I move we approve the Utah project.

Dr. Bogart seconded the motion. Motion carried.

R E P O R T S O F S P E C I A L C O M M I T T E E S

TESTING OF INBRED LINE CONCEPT

George E. Nelms
Ralph Bogart
Carl B. Roubicek, Chairman

NUTRITION AND FEED EFFICIENCY

C. C. O'Mary
J. A. Bennett
R. L. Blackwell, Chairman

TESTING OF INBRED LINE CONCEPT

We came to the conclusion that for suggestions and in order to arrive at some recommendations there was no better place to go than to the W-1 Technical Committee itself.

We asked for the stations to:

Provide line designations and a brief description of inbred lines.

List the performance traits considered essential criteria.

State opinion regarding procedures that should be used in line testing.

State opinion as to alternate programs to line testing.

We divided the replies and will report on the lines, the traits that are important, and the alternatives.

Lines Available for Testing from W-1

George E. Nelms

The lines indicated below are the response to the circulated questionnaire. If omissions were made it was unintentional. There are a total of 33 Hereford, 1 Shorthorn, and 2 Angus lines.

Of the Hereford lines, it would appear that all but four lines are satisfactory for testing. These four lines are known to carry hereditary defects. Also, included in these lines are four new lines. Two of the Hereford lines are polled.

Following is a list of the lines by station with comments added:

Colorado:

Eight Hereford lines--Brae Arden, Colorado, Don, Monarch, Prospector, Royal, San Juan, and Tarrington.

These are the 8 top of 16 lines developed at the Colorado Station. Inbreeding coefficients of the lines vary from 40 to 60 percent. All lines are one or two sire lines.

Montana:

There are five lines of purebred Hereford from five different backgrounds.

Bozeman ROP line. Developed with milk inbreeding and selection based primarily on rate of gain. The line has been closed for 20 years and maintained as a two-sire line.

Havre Lines 1, 2, and 3. These three lines originated from different sources. The lines have been closed about 20 years and maintained at about 40 cows each.

Havre Line 4. This line contains purebred and grade cows. The purebred cows came directly from the Miles City Line 1 and the grade cows have been graded up from Line 1.

Nevada:

Five lines were founded in 1955. Selection has been on a single trait based on postweaning performance. All lines are maintained at 30 to 35 cows, with inbreeding averaging 5 to 14 percent.

New Mexico:

One line is available for testing, the "Old Line." The average inbreeding of this line is about 30 percent.

Oregon:

Two Hereford lines are in the process of being developed. One line combines the Oregon Lines 1, 2, and 3, while the other line combines the Oregon Lines 1, 2, and 3 and Miles City Lines 1, 4, and 10.

One Angus line is available. This line has been closed about 20 years and is maintained at about 20 cows.

Utah:

There are two Hereford lines at Utah. One line is based primarily on Advance Domingo breeding. The other line is based on a combination of several families.

In addition, the only Shorthorn line in the W-1 project is available for testing.

U. S. Range Livestock Experiment Station:

There are seven Hereford lines available for testing, of which one is polled. For a description of the lines, see Montana Agricultural Experiment Station Bulletin 602.

Wyoming:

Three Hereford lines are available for testing. The Gillette line is located at Gillette, Wyoming. This line has been closed since 1953 and is based on Brae Arden breeding. Selection has been for yearling weight and fertility. The other two lines are located at Laramie. One line is selected for yearling weight and the other for carcass desirability. All lines are maintained at about 35 cows.

In addition, one line of Angus is available. Selection in this line has been for yearling weight and carcass desirability.

Essential Performance Traits and Line Test Procedures

Carl B. Roubicek

I. Performance traits to be included in a line-test program, listed in order of priority from replies received:

1. Reproductive performance
2. Postweaning gain:
 - a. Feedlot test for bulls
 - b. 18-month weight for heifers
3. Maternal ability
 - a. Suckling gain
 - b. Weaning weight
 - c. Longevity
 - d. Milk production
4. Carcass merit:
 - a. Cutability
 - b. Carcass composition
 - c. Carcass grade
 - d. Body composition

It is not clear if this information is to be obtained from bulls or steers or both.

5. Feed efficiency:
 - a. Gain: feed consumption ratio
 - b. To be used in conjunction with carcass or body composition
6. Calf survival:
 - a. Preweaning
 - b. Postweaning
 - c. Defects
 - d. May be considered as a part of maternal ability
7. Other items:
 - a. Mature body size (cows)
 - b. Efficiency of cow productivity
 - c. General combining ability
 - d. Bull fertility--semen tests and actual breeding performance
 - e. Genetic lethals and abnormalities

II. Line-test procedures:

The suggested procedures to be used in a line-test program were more variable than the suggested items to be evaluated.

1. Use as many locations as possible to determine possible genotype and environment interactions:

There appeared to be a general feeling that this is an important area that requires more effort. The possibility of using private herds and feedlot cooperators should be considered by individual stations. It was suggested, also, that commercial organizations should be contacted to see if they would use semen from W-1 lines.

2. Use a design to obtain complete top-cross heifer performance:
 - a. Sire-line evaluation
 - b. Mate with industry sires
 - c. No one offered a specific design or plan

Other suggestions:

1. Obtain both specific and general combining ability
2. Use inter- and intra-breed comparisons to determine general combining ability
3. Use constant feed and management procedures for postweaning performance data
4. Use at least four sires per line
5. Use random allotment of test cows in sire groups
6. Contract with a packing house to get carcass data
7. Compare top-cross progeny with industry cattle
8. Get help from Clay Center

All insist that a line test program must include genetic-environmental interaction. This is universal. And second, we do have to get careful, accurate, and complete data on maternal qualities. These are the two unequivocal requirements of a good line test.

Suggestions for Alternative Programs

Ralph Bogart

In general, the feeling of the members of the W-1 Technical Committee is that we are engaged in an important program of line testing and that it definitely should be completed and properly done before attention is diverted to other programs. There was one suggestion made that perhaps we should attempt to do some other things in addition to line testing. Most of the people at stations that are not involved in line testing felt that such stations could be making other

studies that would be of use to everyone in the region.

It was generally agreed that when the line testing program was approaching completion we should have alternative programs of regional interest, and some excellent suggestions were made:

1. Obtain information on the best way to measure feed efficiency and obtain genetic parameters on the trait
2. Develop basic biology of the bovine
 - a. Cytogenetics
 - b. Physiology
 - c. Endocrinology
 - d. Metabolism
3. Evaluate crossbreeding schemes and develop sound crossbreeding programs for industry use. One suggestion was to investigate the use of synthetic populations developed from combination of lines for crossing to give improved production. The idea is that such synthetic populations, if they gave strong hybrid vigor in crosses, could be maintained for such purposes and used by the livestock industry. Another idea is the use of bulls from inbred lines of the same breed in rotational crossbreeding compared with the use of inbred bulls of different breeds used in rotational crossbreeding.
4. Develop precise measures for determining growth potentials.
5. Establish more exact values of the genetic correlations of reproductive performance with other (metric) traits.
6. Develop methods for establishing the genetic "fitness" range of cattle.
7. Importation of exotic stocks for testing and search for new test traits and criteria.

NUTRITION AND FEED EFFICIENCY

Effect of Variation in Quantity and Quality of Nutrients on Efficiency

C. C. O'Mary

The above topic is rather broad in scope. For this reason it is broken down into effects of various nutrients on feed efficiency.

One of the criticisms immediately encountered in computing feed efficiency in terms of unit of weight gain per units of feed required is that weight gain alone is not a suitable criterion since the chemical composition of the gained tissue may be different. Nevertheless, because many experiments do not give data on chemical composition, the report here will deal at least in part in terms of pounds of feed required per 100 pounds gain (or Kg. of feed required per Kg. weight gained). Some experiments have been cited to show the variability encountered in results obtained on feed efficiency.

A. Effects of Variation in Carbohydrates (Energy) on Feed Efficiency

Willey et al. (1952) found when comparing feed efficiency in steers on rations of different productive energy levels (57.85 therms vs. 63.89 therms) the average feed/cwt. gain (pounds) was 824 and 822, respectively. When the productive energy levels were 59.12 and 65.18 therms, the average feed/cwt. gain was 710 and 733 pounds, respectively. Differences were not statistically significant.

Steers fed at two energy levels of 70 and 81 meg. cal/100 lbs. resulted in 739 and 704 pounds of feed per 100 pounds gain, respectively, at one protein level (11 %); 800 and 762 pounds of feed/cwt. gain, respectively, at another protein level (19%). Consequently, in this study increased energy density significantly ($P < .05$) reduced the amount of feed required per unit of gain (Erwin et al., 1963). Stone and Fontenot (1965) fed three different available energy concentrations. They found that digestibility of dry matter, organic matter energy, and NFE increased ($P < .01$) and digestibility of crude fiber decreased ($P < .01$) with each increase in available energy concentration.

B. Effects of Variation of Protein on Feed Efficiency

Steers (38 in each group) fed 11 and 19 percent protein at one energy level had feed efficiencies of 739 and 800 pounds of feed/cwt. gain, respectively, while at a higher energy level the respective feed efficiencies were 704 and 762 pounds of feed/cwt. gain (Erwin et al., 1963). These workers stated that the feed efficiency of the steers was significantly ($P < .05$) reduced when

the percent of dietary protein was increased from 11 to 19 percent. (These calves averaged about 650 pounds [starting weight] and gained about 2.5 pounds per day for 90 days).

Haskins et al. (1967) fed rations with 11 percent and 14 percent protein and obtained feed efficiencies of 6.39 and 6.06 average feed per Kg. gain. These workers stated that mean differences for average feed conversion rates were not significant (20 steers per treatment).

C. Effects of Variation in Fat Levels in Ration on Feed Efficiency

Willey et al. (1952) fed two levels of fat (2.92 and 7.54 percent). The respective feed efficiencies were 822 and 733 pounds feed/cwt. gain.

Bohman et al. (1959) fed 0.5 pounds of fat per head daily to growing beef cattle. The feed required per pound of gain for no fat vs. added fat on three types of rations were 14.4, 15.5; 9.9, 9.8; 11.6, 11.5, respectively. Lofgreen (1965) fed 2.5, 5.0, 7.5, and 10.0 percent fat. He stated that there were no significant differences in the performance of animals fed the various fat levels except for the decrease in feed required per unit of gain as fat level increased.

The feed required per Kg. gain was 8.46 for the control group vs. 9.09 when 5 percent fat was added to a ration fed to steers (Bradley et al., 1966). In this experiment the inclusion of fat decreased ($P < .01$) apparent digestion of dry matter energy and NFE. A digestion trial was conducted along with feedlot trials.

D. Effect of Variation in Minerals on Feed Efficiency

Perry et al. (1962) fed supplemental vitamin A to groups of Hereford steers. The control group were fed in accord with NRC recommendations (1959). The levels of vitamin A added were 2000, 4000, 8000, 14000, and 32000 IU. Feed efficiencies were 1300 pounds feed per cwt. gain for control and 1206, 1282, 1221, 1347, and 1180, respectively, for the various levels of vitamin A. In a second experiment the levels fed and feed efficiencies were as follows: Vitamin A per steer daily, 0, 10,000, 20,000, 30,000, 40,000, and 50,000. Feed per 100 pounds gain, 920, 857, 847, 858, 847, and 826.

Summary

The experiments cited above indicate that variation in nutrients can influence feed efficiency markedly. Changes in feed intake may be affected by the quality of a ration. When feed intake is reduced, gain is usually reduced and feed efficiency is affected. Efficiency

of feed utilization has been reviewed by Meyer and Garrett (1967). They point out several factors which must be considered. Some of these are variations in moisture content, soil contamination, and net energy of the feed, the rumen fill, and the fat content of weight gained.

These workers have brought out several significant points concerning the limitations of the use of the common efficiency expression, "feed per unit of gain."

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EFFICIENCY OF FEED UTILIZATION RELATIVE TO COW MAINTENANCE AND CALF PRODUCTION

R. L. Blackwell

Efficiency of feed utilization relative to cow maintenance and calf production is an important portion of total beef production. It includes body size, milk production, and reproduction. The effect of body size is reasonably well understood; however, most of the research has been done with dairy cows and growing beef animals rather than producing beef cows. Beef cows are not efficient producers of milk as a general rule because of the low production relative to maintenance requirements. A crude statement of gross efficiency of the beef cow may be written as:

$$\text{Efficiency} = \frac{\text{Total weight of calves weaned} + \text{salvage weight of the cow}}{\text{Total feed for the cow} + \text{feed for the calves}}$$

The denominator includes energy required to produce the cow (from her own conception to puberty), total energy required to maintain the cow from puberty to the end of her productive life, and energy consumed by the calves up to weaning that is not supplied by the cow. Variable quantities in the numerator are number of calves produced (this depends on reproductive rate and length of reproductive life), average weaning weight of calves, and weight of the cow.

Factors which tend to increase efficiency are age at puberty, length of reproductive life, weaning weights and reproductive rate. Of these, reproductive rate appears to be the most important in altering efficiency. Calf weight, per se, can be produced only by providing energy above that required to produce the cow to reproductive age. High reproductive rate tends to reduce the maintenance requirement per calf after puberty. A long reproductive life tends to reduce the initial cost of producing the cow per year of reproductive life.

Reid (1960) discussed the effect of energy intake upon reproduction in farm animals. He states that a low intake of energy during early life greatly retards the onset of puberty in cattle. The effect of feeding level upon the number of services for conception in cattle has been variable among different experiments. There is a definite tendency for cows reared on a high plane of nutrition to encounter breeding difficulties later in life and, thereby, have a shorter productive life compared to cows reared on a low intake of energy.

Wiltbank et al. (1965) studied the influence of total feed and protein intake on reproductive performance of beef females. Some of the main effects of low intakes of energy and protein were failure to reach puberty, failure to come into estrus following calving, reduced growth of calves, and milk production. Those animals which were fed a high roughage ration and that were previously on the low energy ration had high conception rates. For those heifers that showed estrus and ovulation, there was little difference in conception rates related to feed intake.

Knox (1957) reported substantial differences in the production of range cows of different sizes and pointed out that the difference in annual production per 1000 pounds of cow were due primarily to the rate of reproduction.

Gifford (1949) reported correlations between milk production of the dam and monthly gains of the calves that ranged from 0.7 to 0.2 over an eight-month period. Milton et al. (1967) reported correlations between calf gains and estimated total milk production to be on the order of 0.4.

Baumgardt (1967) concluded that efficiency of production in dairy cows will increase with increasing digestible energy intake up to the point where body fat is deposited at a significant rate. Klosterman et al. (1968) reported a high correlation ($r = 0.89$) between condition score and weight:height ratio. An equation was derived which would adjust maintenance requirements of cows that varied in condition.

Guilbert and Loosli (1951) make the following generalizations:

In a broad sense the total feed capacities of the various species are proportional to the same fractional power of body weight as maintenance requirement and basal heat production. There is no fundamental difference, therefore, between large and small animals in efficiency of feed utilization for growth that depends upon body size as such. Species or individuals that have higher than average relative feed capacity (feed intake in relation to basal heat production) during early growth stages tend to be higher in efficiency of feed utilization.

Hodgson and Wilkinson (1967) found a high relationship between live weight and herbage organic matter intake of grazing heifers and cows. The best fit exponent of live weight for the pooled results was 0.61. The exponent increased to 0.71 when the cow data were excluded.

Efficiency of feed utilization in dairy cattle has been studied by Stone et al. (1960). They reported a high relationship between efficiency, defined as pounds of TDN required to produce 100 pounds of fat-corrected milk, and total milk production ($r = 0.71$); thus, the higher the production the lower the TDN requirement for 100 pounds of milk. The correlation between the efficiency and body weight was small ($r = 0.08$). There were highly significant differences among cows in forage dry-matter intake. The repeatability of weekly consumption was of the order of 0.7 when body weight and milk production differences were removed by covariance technique. Twenty-five percent of the variance in forage dry-matter intake was associated with variation in milk production, body weight, and daily change in body weight.

Jones et al. (1965) concluded that it was permissible to add 0.24 pounds digestible organic matter intake per pound of fat corrected milk to the digestible organic matter intake associated with the 0.73 power of body weight up to a level of milk yield of 50 pounds per day.

Meyer and Nelson (1963) conducted an experiment on feed utilization by various animal species fed similar rations. Some of their findings include:

1. The total efficiency of feed utilization in terms of live weight gain per unit of feed intake was lowest for ruminants, with sheep being somewhat more efficient than steers. Pigs were intermediate, followed by rats, with the chick being the most efficient in the use of their feed for live weight gains.
2. By calculating efficiency of feed utilization in terms of energy gained per unit of feed intake, a different picture was revealed than that obtained with live weight gain. Here, pigs were the most efficient, followed by sheep, steers, chicks, and rats in descending order.
3. Protein gain was greatest per unit of feed intake for the chicks, followed by rats, pigs, steers, and sheep.
4. Feed capacity measured as feed consumed per unit of metabolic size was correlated with efficiency of utilization in terms of energy gains ($r = 0.91$). Ruminants utilized approximately 50 percent of the net energy for maintenance.

Blaxter et al. (1966) studied the utilization of energy and protein in the same diet of cattle of different ages. They reported no systematic trend of apparent energy digestibility with age of animal, nor was there a systematic change of digestibility with increased intake of diet. The proportion of protein energy in the gains fell with increasing age from 43 percent in animals at 15 weeks of age to 34 percent in animals 81 weeks of age. The composition of the gains showed that protein energy accounted for 30.5 percent of the total energy retained in 15-week old animals and 24.8 percent in animals 81 weeks of age. Taylor et al. (1962) state that up to about two years

of age efficiency had generally shown a fairly regular decline with increasing age. Since maintenance requirements increased steadily with increasing weight, and since growth eventually ceases, efficiency must steadily decline.

Freeman (1967) states that selection for increased feed efficiency (gross energetic efficiency) for the production of milk would be effective in dairy cows. Because of the high genetic correlation between milk production and efficiency, and because the ratio of the heritabilities of these traits appears to be approximately equal, selection for milk production alone will automatically select for increased feed efficiency.

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Feedlot Efficiency

J. A. Bennett

Efficiency of feed utilization during the feedlot period has particular significance to cattle breeders because it is during this period that most performance tests for rate and efficiency of gain are made. Feedlot efficiency, of course, has much significance to commercial cattle producers, also.

Much has been written and discussed concerning measuring efficiency of beef animals on a feeding test. It is not my purpose here to review all of the literature with you, but to bring to your attention some of the related facts associated with measuring efficiency and the implications these may have to our W-1 breeding effort.

Efficiency of feed use is not a directly measurable trait but is a function of feed consumed, gain in body weight, and time (Koch et al., 1963). Several factors may influence this calculated estimate of feed efficiency. Probably two of the most readily apparent variables among animals going on a feedlot test are differences in age and in size. In most tests the two are confounded because as the animals get older they also get larger. Differences in size have been studied by numerous workers who have been unanimous in the conclusion that efficiency decreases as body weight increases. Figure 1 illustrates a somewhat characteristic situation for beef bulls on full feed. Age probably has an influence over long periods of time, as it was shown early that metabolic rate declines with advancing age in individuals of the same size in man (Magnus-Levy, 1899). For beef animals on test during the interval of from approximately seven months of age to 15 months, the age influence independent of body size is probably not large. Growth during this period approximates linearity in most modern strains of beef cattle. In "early maturing" strains some decline in growth rate may occur before 15 months with marked changes in composition of the tissue deposited and in this case age would have an influence. If in evaluating efficiency differences in body size and in composition of gains are properly taken into account, age is not likely to be a source of major variation in conventional tests.

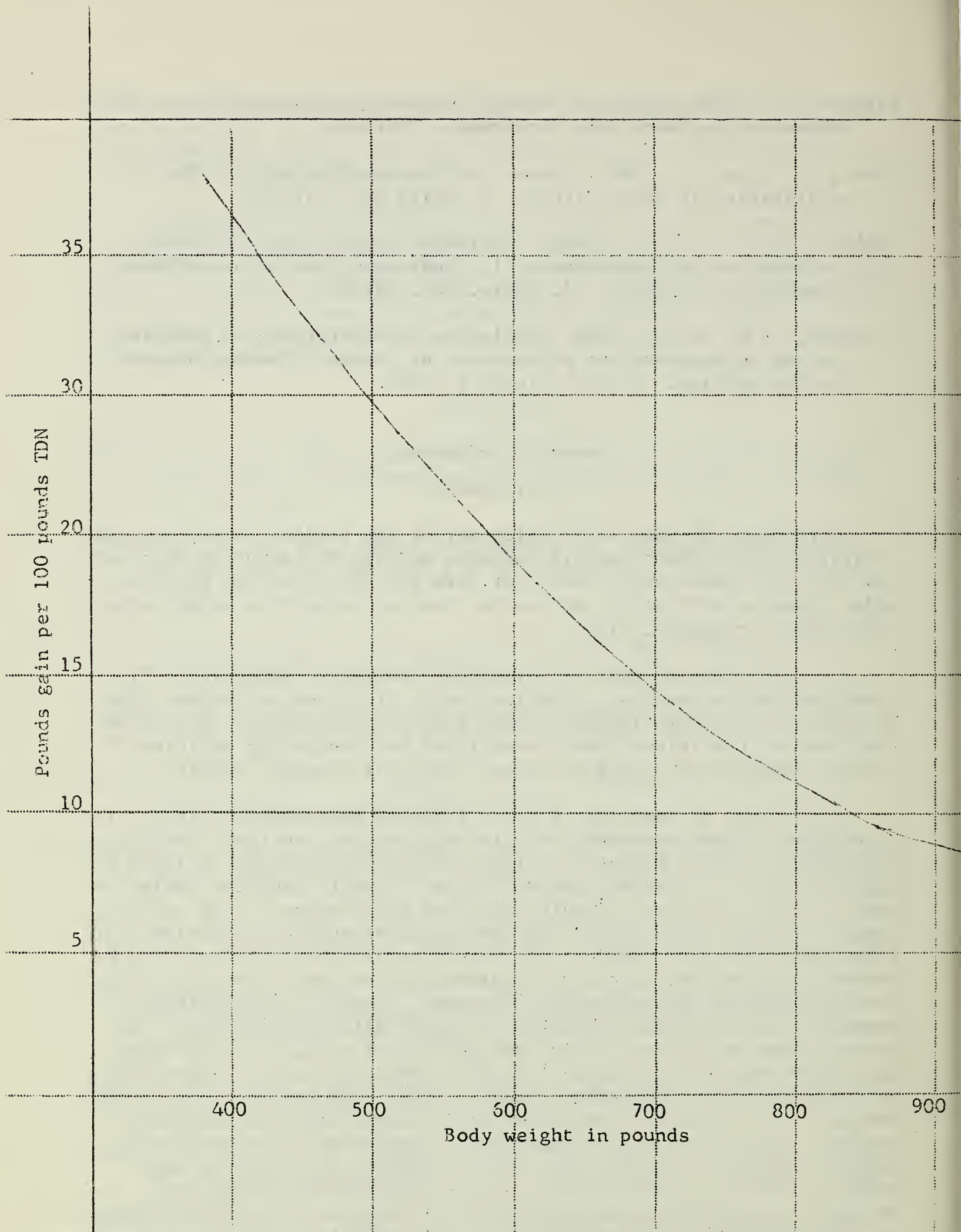


Figure 1. Body Weight and Efficiency Relationships

Other variables that influence the indirect measure of efficiency are level of feed consumed and the composition of the weight gained. Animals differ in appetite. This is very likely a valuable economic characteristic. Research reported by Garrett et al. (1959) on both sheep and cattle indicate a linear relationship between feed and gain. Winchester and Hendricks (1953) show a similar linear relationship for cattle. This type of relationship has been demonstrated to hold over most normal gain ranges (from zero to approximately 3.0 pounds daily gain).

Butcher (1964) presented results from lamb feeding trials that have some interest to cattle breeders. Relationship between average daily feed consumption and average daily gain was linear. If this was assumed as perfect relationship, then the resulting relationship between gain and feed efficiency was shown to be a rectangular hyperbola. Accepting this was helpful in interpreting some of the experimental results. For example, pelleting the feed gave a significant increase in feed efficiency, but when covariance analysis was applied the increase was indicated to be a result of increased feed consumption. Stilbestrol and oxytetracycline, however, gave increased feed efficiency independent of feed consumption.

In application to performance testing in beef animals, if the only differential between animals is in increased appetite there would be an expected shift to the right on the curve. If there were a real difference in net feed efficiency then the curve itself would shift.

Consideration of quantity of feed eaten is, therefore, necessary before differences in net efficiency can be measured. Covariance analysis is useful for this purpose in groups of animals. The difficulties associated with comparison of individual animals are apparent.

Knapp and Baker (1944) indicated there is a high correlation between rate of gain and efficiency of gain. Many other workers have verified this and coefficients of determination (r^2) of approximately 0.75 have often been reported. On the basis of this, most recommendations on performance testing have indicated individual feed consumption records are not necessary. This recommendation warrants careful examination.

The Colorado Agricultural Experiment Station (Lickley et al., 1960) found that selection for daily rate of gain could be expected to increase efficiency and mature size in about equal amounts. The desirability of increasing mature size over a long period of time bears attention. Some further increase in size may be desirable for a time. However, increase in size very likely means a changed growth curve and differences in body composition at a given weight. This may soon lead to a less desirable market carcass. Increased size also suggests that the apparent increased efficiency may actually be a change in relative body composition without any real change in true efficiency.

With these points in mind, it seems that beef cattle breeders are approaching the time when more attention must be given to measuring efficiency of feed use. There is need for basic studies to measure the value of the components that contribute to efficiency. Differences in true efficiency of feed use would appear to arise from:

1. Differences in basal metabolism
2. Differences in ability to digest and assimilate feed
3. Differences in energy value of tissue stored

Only limited information is available on our modern beef breeds and strains for any of these three areas. In many cases techniques and methods must be developed or adapted before suitable measurements can be taken on beef animals. For example, there is a great need for a rapid, accurate technique for estimating body composition in live cattle of all ages under field conditions. Until this technique is available, precise measures of efficiency will be very expensive. Similarly, more practical, simpler, faster, and lower cost means of measuring basal metabolism and digestion are needed for application to cattle.

Personally, I feel we are approaching the point in cattle breeding where efficiency cannot be further ignored. It seems desirable that the W-1 project give increased attention to this matter.

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W - 1 C O O P E R A T I O N W I T H
U N I T E D S T A T E S M E A T A N I M A L R E S E A R C H
C E N T E R
C L A Y C E N T E R , N E B R A S K A

R E G I O N A L B U L L E T I N

E F F E C T S O F I N B R E E D I N G

C. M. Bailey
W. C. Rollins
J. S. Brinks,
Chairman

C O M P U T E R P R O G R A M S



W-1 Cooperation with USMARC

Cooperation between W-1 and the United States Meat Animal Research Center, Clay Center, Nebraska was discussed, and Dr. Frevert, Director of the Arizona Agricultural Experiment Station, requested a summary which he could present to the Agricultural Research Planning Committee and to the Western Association of Agricultural Experiment Station Directors.

Dr. Christian:

Dr. Frevert, we have discussed this matter briefly as a group and the general consensus of the W-1 Committee is that one of the objectives of the Clay Center operation was to provide cooperation between that group and the various state stations, particularly in research that can be done on a cooperative basis. We have in the Western Region a line testing project that has been in operation for several years and which now has been terminated. The feeling is that this is one area where Clay Center can be of service, providing facilities and services for a line testing program. This can be expanded into more than a Western Region project--much more extensive than we have attempted in this region. This is one area in which we would like cooperation.

Another is the maintaining at Clay Center of a control herd with which the individual stations could compare their own lines which have been developed.

Another point is that in a number of the lines developed in the Western Region semen has been collected and frozen, and this would be an excellent place for storing frozen semen and also determining progress made in past generations in a particular line.

The philosophy of the people now involved in Clay Center is that our idea of cooperation and their idea of cooperation is not the same. We had visualized it as a two-way cooperation. They seem to be interested more in an exchange of personnel (personnel cooperation), but we feel we need more an exchange of experimental animals, an opportunity to use Clay Center as an adjunct to our own regional project. And with such cooperation, it would be possible for the people at Clay Center to ask particular stations to carry out research projects which lend themselves to smaller groups of cattle, while on the other hand we could ask them to cooperate in projects which require large numbers of cattle.

This is the kind of cooperation we would like to see between Clay Center and our group in particular, and other groups generally.

The letter written on March 21, 1968 by Dr. Donald F. Hervey, Chairman, Western Association of Agricultural Experiment Station Directors, to Dr. R. E. Hodgson, Director, Animal Husbandry Research Branch,

was endorsed as representing the feelings of the W-1 Technical Committee members.

March 21, 1968

Dr. R. E. Hodgson, Director
Animal Husbandry Research Division
Agricultural Research Service, USDA
Beltsville, Maryland 20705

Dear Dr. Hodgson:

On several occasions the Experiment Station Directors of the Western Association have expressed a desire to develop a cooperative relationship with the national laboratory being developed at Clay Center, Nebraska. On one occasion, I mentioned to Dr. Irving the fact that I thought this new laboratory facility offered unique possibilities for federal-state cooperation in the development and carrying out of joint research programs.

At this time it is my purpose to reiterate this interest and indicate our willingness to participate with you in whatever way possible in the development and design of a plan which will provide for coordination of efforts between states and the new laboratory. One of the mechanisms available to us is through the regional research program.

Dr. J. H. Meyer, Administrative Advisor to Regional Project W-1, recently indicated to me that he would favor close coordination between the work of that committee and the work at Clay Center. For this reason, we would like to encourage either Dr. Keith Gregory or Dr. E. J. Warwick to participate in the W-1 meetings to be held in Tucson, Arizona and on the San Carlos Reservation, April 3-6, 1968. It would seem advisable to maintain close communications between members of the W-1 Technical Committee and staff at Clay Center.

Please feel free to call on the Western Association of Experiment Station Directors if we can be of help to you.

Yours truly,

/s/ Donald F. Hervey

Chairman
Western Association of Agricultural
Experiment Station Directors

Regional Bulletin

Dr. Brinks:

Our committee has been functioning. We divided the assignments as follows: Bailey--Introduction, Rollins--Review of Literature, and Brinks--Materials and Methods. The introduction has been written. Dr. Rollins has a report on the literature review.

Dr. Rollins:

I made an outline of the approach to the literature review and I particularly wanted to discuss it today because I go on my sabbatical next summer and I am afraid I may not get it written. The committee may want to take some action. I have some background suggestions for the literature review:

Restrict the review to pertinent genetic traits.

Mention W-1 publications on inbreeding or list in a separate section all papers not included in the review so as not to duplicate.

A review of the papers already published by W-1 on inbreeding should be in another section of the bulletin rather than in the literature review.

References earlier than the Shrode and Lush paper would not be reviewed but merely listed in the bibliography.

We need to collate references from Roubicek, the ones I have, and ones listed in the Beltsville symposium in 1965.

Dr. Bogart:

I am at a loss on your recommendations. Do I understand you will not review a lot of this material but put it in the list of references at the end?

Dr. Rollins:

I would recommend that W-1 work which has already been published be listed in a separate section of the bibliography as W-1 publications. Then in the review of the literature it be put in a section or integrated with the writing of the bulletin, because the bulletin itself is being based on a consolidation of material already published.

Dr. Bogart:

I question whether we want a group of references in the list of references that are not referred to. This may cause confusion.

Dr. Brinks:

In the Materials and Methods section we have tables prepared on a number of lines as to numbers, years, etc. I am now working into tabular form the information from stations on the questionnaire that was sent out.

The analyses have not been started yet. The inbreeding coefficients must be brought up to date before analyses can be started. I hope to get the tabulations out to our subcommittee this spring, and we want to have this portion of the bulletin completed by this fall.

Dr. Christian:

What do you visualize as the publication date?

Dr. Brinks:

That will depend on when the inbreeding coefficients are completed. The Miles City Line 1 is causing a great deal of trouble.

Mr. Knapp:

I have partitioned Line 1 into three portions and it is still too big for the computer. Line 1 is the basis for some of the other lines, so it will be a matter of getting certain relationships out and then running the other lines. I hope it will be done this spring.

Dr. Christian:

I am hoping to get a publication date at which we can shoot.

Dr. Brinks:

Up to the analysis, this fall is a good date. Hopefully, some analyses can be started by then.

Dr. Christian:

Then another year we should have a good report on the bulletin, including some analyses? Do you think there might be a rough draft of the bulletin by then?

Dr. Brinks:

I would think so.

Dr. Christian:

On the agenda for the 1969 meeting will be a discussion of the rough draft of the bulletin.

Computer Programs

Dr. Christian:

A memorandum was sent out regarding computer programs available and the types of computers for which they were designed. Since a number have switched computers in the past year, we should have a review of what programs the stations have which might be of interest to the group. You can then contact the individual station that reported the program and find out about it.

Arizona:

CDC 6400. The program we are working on is a generalized means working program.

Colorado (Mr. Knapp):

I have a least-squares program--CDC 6400 in Fortran 4. It can be converted to other machines. The generalized read routine would have to be rewritten for your machines.

Other programs are generalized means and nested program for 360 Fortran 4, E level, and generalized 1620 programs and their write-ups.

CDC 3600 and IBM 7090--analysis of variance, discriminant analyses, frequency counts.

Inbreeding program--CDC 3600, written in Fortran 2.

MPPA program developed in the past few weeks for the CDC 6400.

Dr. Brinks has a simulated selection program developed by Harvey. It is used for selection studies--weaning weight, yearling weight, birth weight. It is Fortran 4.

Hawaii:

I doubt if we have any programs you don't already have. IBM 360 and 7040 are what we use the most. I am interested mainly in programs for 7040 and 360.

Idaho:

We have just obtained a copy of the least-squares and maximum likelihood prepared by Harvey at Ohio. It is being modified for our computer department. It should be available for the 360 soon. This is written in Fortran 4-E. If anyone is interested in the program when we get it modified, we will be glad to send it.

We also have a linear programming program written in MPS which was developed at Idaho and is being used in nutrition. I am not sure

what this involves. If any of you are interested in linear programming I can get more information for you.

Montana:

We just got Harvey's program but it has not yet been looked at. Our new machine is a Sigma 7. It has a lot of computer capacity. We have been told it is a very effective machine. Harvey is coming in June to straighten us out with it.

Nevada:

We have a 1620, so all we have is the Beltsville library. We just got a Sigma 7. What we are looking for is Fortran programs which can be converted to a Sigma 7.

Wyoming:

We have a Philco, a big one. We do have one program that might be of interest. Two-way nests built into it--least-squares type program. We have a parent-offspring type Fortran 4.

I would like to have a least-squares program that will analyze missing subclasses.

B U S I N E S S M E E T I N G



COMMENTS OF COOPERATIVE STATE RESEARCH SERVICE REPRESENTATIVE

Dr. Sierk:

This regional beef cattle breeding research has been going on for some 20 years. I am sure it is easier to look back on 20 years than it is to look ahead 20 years.

A few general comments on funds. I think you are all familiar with what has happened this past year so far as appropriations are concerned. It is the first time such a situation has developed, where an appropriation was made then it wound up being less than was appropriated. For the fiscal year 1969, at least the budget that has gone to Congress and has been defended to the subcommittee, is a restoration of the 1967 budget. Roughly, if it goes through as it has gone to the Congress, it would be an increase of 7 percent over the current year. There are no indications at this time what the situation might be.

The general procedure now, so far as budget making is concerned, is just like your computer programs--it is getting to be a complex situation. There is a general method of developing budgets called Programmed Planning Budget System. A very important part of this budgeting now is a so-called cost:benefit ratio. I don't know whether any of you have been confronted with this idea of developing a cost:benefit ratio, but if you have some spare time just sit down and try to do it. But the fact remains, it is with us. We might in some respects consider ourselves most fortunate if we consider that the larger share of our agricultural research is still being applied. There is no question that the research we do does have an end product.

All I can say to you is that it is on this basis that budgets are being developed, and at the present time the budget is being prepared for 1970. Congress has the 1969 budget.

By and large, research planning is still tending to follow the projections that were made in the long-range study. What events transpire between now and the time appropriations are made, whether it is Viet Nam or some domestic crisis, there is no way of knowing. But all of these things have an effect on what actually comes out.

There is in review, at least, at the present time a new approach to allocating regional research funds. You know that of the total Hatch appropriation, which is approximately \$50 million, the Hatch Act itself says that up to 25 percent of this must be allocated to projects in which two or more stations are represented and which are recommended by a committee of nine persons--two directors from each region and a home economics representative--to the Department of Agriculture. These funds do not require matching, as do regular Hatch funds. For many years these funds have been distributed by station directors on a formula basis. There was a request that this be made a part of the distribution of the total funds. The General Counsel said in effect,

"That can not be. The law says these funds have to be allocated to projects, not to regions, not to stations." So, now we are in a transition period.

This doesn't suggest changes overnight, but it is quite clear that there will be some changes. The thing I want to leave with you in this regard, and there is some skepticism, this means that instead of allocations to the stations someone is going to have control rather than the stations. The law states these funds shall be directed by this Committee of Nine. None of these funds can be allocated except to a project recommended by this Committee. So, control is still there. The money can not be allocated to projects developed in Washington unless they could get the Committee of Nine to go along, and that would be unusual.

By and large, since about 1955 there has been an average of 200 regional projects throughout the United States. The amount of money has increased as appropriations have gone up, and for the current year it is approximately \$10 million. There are other funds besides regional that go into these particular projects. I expect there will be a somewhat smaller number of regional projects as we look ahead.

What is the basis for determining what should be a regional project? There are some guidelines that have been developed for this, and I am sure there will be some additional ones. This is not going to develop overnight, but certainly it is in the picture as we look ahead.

In NC-T95 (beef carcass quality evaluation), stations anywhere in the United States could have a contribution to this regional project. At the present time, any time a project is proposed as a regional project this information is sent to each director, and if a director is so inclined he may send someone to the planning meeting to develop that regional project. I believe there are now about 30 of the 200 regional projects which have participation by stations other than the region of which they carry the project number.

How anyone determines priorities for research--certainly here you are concerned with beef cattle and beef cattle breeding, but it is quite evident that the beef cattle projects have concerned themselves with more than beef cattle breeding, and rightly so. But just because these projects have age on them it makes them suspect. It is said they don't have a real sharp focal point. I am sure at some time in the not too distant future you people will be asked rather specifically to indicate your priorities.

Finding the impact if industry used the information we now have is something that should be done. The population losses alone become almost astronomical--the loss of a calf that does not live, although it is not all loss for there would have been feed costs, and so on. But this matter of the effect on industry of the results of research is something that has been bandied about by research people and economists. Sometimes it comes out that it doesn't build up a very strong case for research, but even though the results might not be all you would expect, it is something that should be attempted.

I can not help but make a comment about coordination, cooperation, joint planning. I guess it is almost unnecessary to say that this is difficult to do. They have talked a lot about it--done some of it. The long-range study said they would do it. The long-range study includes overall facility requirements. I guess at the moment the only thing I can say to you is that we can hope that whoever has the responsibility for pushing this will make it effective.

There is a question that comes up each year about the duplication of effort by the stations and duplication by stations and USDA research programs. Most of the questions one can handle and justify very well, but Congress is not ignoring this and is going to look in this direction in looking ahead.

COMMENTS OF ACTING INVESTIGATIONS LEADER

Mr. Knapp:

All reports are in.

Montana expects to prepare a project revision during the year. A revision of the Nevada project will be ready for consideration at the next meeting. New Mexico's heart defects project terminates in June 1969.

Dr. Warwick is now an Assistant Director, Animal Husbandry Research Division, and Dr. Paul A. Putnam has been named Acting Chief, Beef Cattle Research Branch.

The Investigations Leader position will not be filled during the coming year.

No one from the Branch or Division office could attend this meeting because of a conflict with the meeting of the Animal and Animal Products Advisory Committee, but Dr. Warwick has sent some remarks to be read.

COMMENTS OF ASSISTANT DIRECTOR, ANIMAL HUSBANDRY RESEARCH DIVISION (formerly Chief, Beef Cattle Research Branch)

CURRENT STATUS -- BEEF CATTLE BREEDING RESEARCH

By E. J. Warwick

It is a matter of great regret to me that I can not be in attendance at the 1968 W-1 meeting. Several months ago when the meeting date was set I realized it would be impossible to attend due to a conflict with the annual meeting of the Department's Animal and Animal Products Advisory Committee.

To a greater extent than ever before we are witnessing industry application of results of past cooperative Federal-State research

efforts in beef cattle breeding. The formation of the Beef Improvement Federation during the past year represents a milestone. For the first time it brings the organizations active in performance testing of beef cattle under "one roof." The charter membership of 25 State BCIA groups, nine breed associations, three artificial insemination groups, and three national organizations, representing various phases of the industry is propitious. I'm sure you all join me in wishing the new organization every success in achieving its purposes. Too, I hope we will all actively help it.

All indications point to more industry application of controlled heterosis than ever before.

In other respects we are living in troubled times. Disruptions are occurring in many of our activities. Agricultural research in general, and beef cattle breeding in particular, have felt these disrupting influences during the past few months.

Midway through the current fiscal year, the Congress and the Administration decided that reductions in Federal expenditures were necessary. Rules were laid down at high administrative levels to guide these reductions. Included were provisions that reductions were not to be made in protection-type research, i.e., pesticide residues, leukosis, mastitis, etc., and that Federal employees were not to be discharged or "riffed," to use the Government term.

These provisions made it inevitable that beef cattle breeding including projects such as W-1 would be affected disproportionately as compared to all agricultural research. As you know, all cooperative agreements in W-1 were discontinued. This has necessitated discontinuance of the regional line-testing project as well as adjustments in individual projects partially supported by cooperative agreements. Further, the W-1 Investigations Leader position was vacant and funds for it were included in the reduction.

Funds for other beef cattle research of the Division were reduced. Overall, including the U. S. Meat Animal Research Center, Clay Center, Nebraska, the reductions amounted to 12 percent of the fiscal 1968 funds. The President's budget for fiscal 1969 includes further reductions, making the prospective total about 16 percent of the 1968 base. Of course, reductions have occurred, also, in work with other species.

Congress has yet to act on the President's budget for fiscal 1969, but at present it is our best estimate of probable fund availability. If adopted, there will be no possibility of restoring either the W-1 cooperative agreements or the Investigations Leader position.

If desired by the W-1 Committee, it is presently planned that the regional office will be maintained at Fort Collins and that Mr. Knapp will continue to render essential services to the regional project. It must be remembered that his primary function is data analysis and publication, and that it will be impossible for him to provide the consultation on project development and revision or to make industry

contacts to the degree that Dr. Brinks did in the past.

It is my hope that the Animal Husbandry Research Division and State Agricultural Experiment Stations will continue to work together on important problems as we have in the past. Actually, when and if things return more nearly to normalcy, cooperative effort should increase in the breeding research area.

Some may be inclined to question this statement in view of the apparent low priority placed on these activities in recent budget reductions. I have been assured, however, that the direction budget reductions took was a consequence of the ground rules (discussed earlier) laid down at high administrative levels in this particular emergency situation. The actions do not represent long-term policy.

As mutually agreed to be desirable for maximum research productivity, USDA will continue to participate actively in regional projects such as W-1 within the limits of funds available. This participation and cooperation will likely continue most existing forms including coordination functions as mutually agreed upon, inclusion of research at Federally-owned locations such as Miles City in the efforts, and financial or personnel support at State locations.

In all probability the form of financial support will be mostly, if not entirely, in the form of grants or contracts for specific jobs rather than the continuing type of cooperative agreement, most of which have been eliminated.

In closing, I believe it is appropriate that I mention two things relating to personnel. At least one of these will have a real effect on W-1. Mrs. Mary Neely has indicated her intention of retiring on July 1 this year. As you all realize, this wonderful lady has played no small part in the success of W-1. Certainly I know of no one who is more capable, conscientious, and considerate than Mrs. Neely. It is with real regret that we contemplate her impending retirement. I'm sure you all join with me in wishing her the very best when she has more time to call her own.

I recently undertook a new assignment as an Acting Assistant Director of our Division with special responsibilities for meat animal research in addition to those normally associated with overall Division administration. It is planned that the assignment will become permanent. After more than 12 years in charge of USDA beef cattle research and nearly 18 years as a participant, the new position represents quite a change. Inevitably I will be less close to beef cattle research than in the past. However, the separation is far from complete and I shall look forward to future contacts. I believe our associations in W-1 have been productive in the past and trust they will be even more so in the future. Our associations have been most pleasant and I have greatly appreciated the cooperative spirit of W-1.

Dr. Paul A. Putnam has been named Acting Chief of the Beef Cattle Research Branch.

Again, I am sorry I couldn't be with you in person.

TIME AND PLACE OF NEXT MEETING

Dr. Christian reported that following a motion made at the 1967 meeting he had corresponded with the chairmen of the NC-1 and S-10 Technical Committees regarding the possibility of an interregional meeting. The S-10 Technical Committee felt that a regional meeting could not be held until 1970.

Dr. Ne s invited the W-1 group to meet in Laramie in 1969. Dr. Rollins moved that the 1969 meeting of the W-1 Technical Committee be held on the Thursday and Friday before the Western Section meetings at the University of Wyoming, Laramie. Dr. Bennett seconded the motion. Motion carried.

Dr. Bogart moved that the next chairman start proceedings promptly to see what could be developed for a national meeting with the other two regions at the U. S. Meat Animal Research Center, Clay Center, Nebraska, for the 1970 meetings. Dr. Cobb seconded the motion. Motion carried.

Dr. Bogart moved that rotation alphabetically by station of the chairmanship of W-1 be continued, and that Dr. Blackwell of Montana be the next chairman. Dr. Rollins seconded the motion. Motion carried.

RESOLUTIONS

WHEREAS members of the Animal Science Department of the College of Agriculture, University of Arizona, and especially Drs. C. B. Roubicek and D. E. Ray and their wives and families, have extended many courtesies to members of the W-1 Technical Committee and have provided excellent facilities and services which have helped to make our 1968 meetings a success,

BE IT RESOLVED, That the W-1 Technical Committee express its appreciation to the members of the Animal Science Department and to the Dean of the College of Agriculture for their gracious hospitality.

Motion was made by Dr. Bailey, seconded by Dr. Bogart, that the resolution be adopted. Motion carried.

WHEREAS, Mrs. Mary Neely has served in an outstanding manner in the Western Regional Beef Cattle Breeding Office since shortly after the inception of the W-1 project, and in view of the fact that she has indicated her desire to retire in the near future

BE IT RESOLVED, That the members of the W-1 Technical Committee wish to convey to her their sincere appreciation for her many contributions to the W-1 effort and to extend to her their very best wishes for the years to come.

Motion was made by Dr. Bailey, seconded by Dr. Holland, that the resolution be adopted. Motion carried.

Resolutions Committee:

Dr. J. S. Brinks

Dr. C. C. O'Mary

Dr. C. M. Bailey, Chairman

ADJOURNED



